ELECTRICAL REVIEW

May 25, 1945

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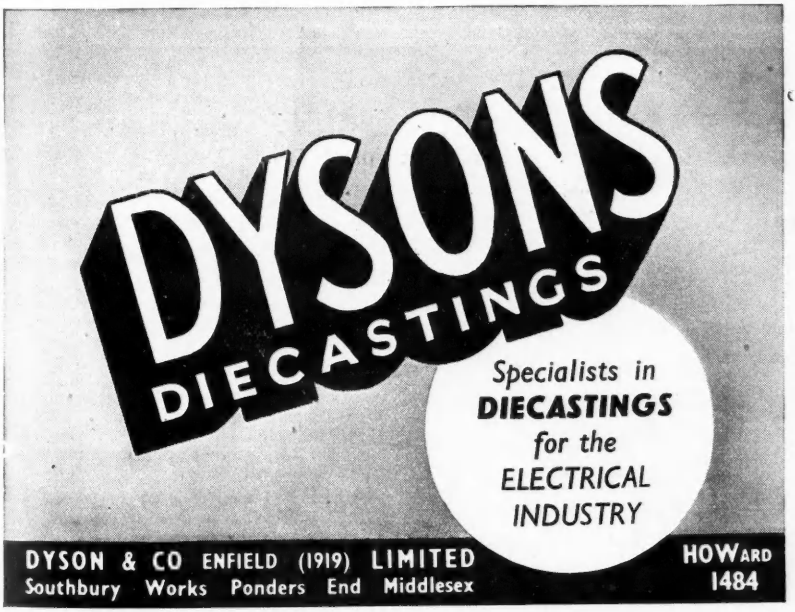

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ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXXVI. No. 3522. MAY 25, 1945 9d. WEEKLY

Preparing for the Worst

Means of Avoiding Cuts in Supply

THOSE who expected immediate relief from stringency in food, clothes and fuel when the European war ended are finding that their hopes are unlikely to be realised. We shall still have to tighten our belts round our ragged apparel and still go easy with coal and its derivatives. The early release of "Class B" men, including some miners, will not have effect for a considerable time and in any event even if supplies of coal to electricity supply authorities are increased and improved in quality there will still be insufficient plant to cope with the anticipated demand during next winter.

Unpredictable Conditions

It is impossible at present to judge what that demand may be. Much depends, in the first place, on the nature of the weather, which, in spite of students of "cycles," still remains unpredictable. More under control, but still indeterminable in magnitude, is the industrial load. Though there will be some falling-off in the production and requirements of war factories, it is to be hoped that the change-over to normal work will be pursued rapidly enough to absorb displaced labour and that will mean no relief for supply authorities.

It is therefore wise to be guided by the experiences of last winter, when a combination of severe weather, heavy industrial and domestic demand, and coal and plant shortage made it necessary on a number of occasions and in most districts to cut off supplies for short periods.

As we have repeatedly said, consumers of electricity look for a continuous unlimited supply and they are likely to be annoyed if the operation of their switches produces no results. In short, it is a bad thing for the electrical industry and if it can be avoided it must be. The Electricity Commissioners fully realise this and consequently have given some advice to electricity supply undertakings on ways in which the inconvenience and annoyance can be mitigated or eliminated.

Reducing Industrial Peaks

Their first endeavour is to secure a reduction of the peak which calls for very close co-operation (one might almost say friendship) with large industrial consumers. If these can be persuaded (and are able) to arrange their works programmes to transfer some of their heavy demand from the morning to the afternoon it may be possible to avoid stoppages altogether. The Commissioners point out that the excess of the morning over the afternoon demand towards the end of last year was 870,000 kW, and during the summer months, when it is necessary to do all the overhauling possible, it will be greater. This last consideration emphasises the need for transferring the load from the morning to the afternoon now.

Another suggested means of alleviating the situation is to take surplus power from private sources and to employ standby Diesel-engine plants. This subject was discussed in the *Electrical Review* of April 6th. There is some difference of opinion regarding the extent of the aid to be secured from this source and there are

some difficulties, as the Commissioners realise. They say that where it is not possible or desirable to parallel these plants with the public supply system special switching arrangements may be necessary. There are no doubt a number of cases, however, in which use can be made of these plants and they may be sufficient to reduce the necessity for the "shedding of load."

Fallacy of Averages

A NOTABLE example of the misleading nature of average figures, unless they relate to units of nearly similar size, is provided by references to coal stocks at power stations. The three and a half weeks' total reserves, which the Ministry of Fuel and Power had expected would be the minimum reached by the end of April (after which it would be replenished, it was hoped, during the coming summer) sounds much better than it really is. If deliveries were short or plant were out of commission at a large base-load station, the inroads on the stocks at small stations connected with it would, of course, be far greater than those due to their normal running.

Ash Handling

EACH year probably nearly 3,000,000 tons of ashes remain as products of combustion at electric power stations. The amount of attention given to the subject seems hardly commensurate with the appreciable increase in the costs of generating electricity entailed in their disposal. Particulars of operating and maintenance costs of ash-handling systems are not easily available. Figures quoted by Mr. T. H. Carr in the paper he read recently before the Institution of Mechanical Engineers, indicate the wide variations that exist between individual installations. There are, no doubt, sound local reasons for the discrepancies, but investigations into the factors governing them would be facilitated if the costs of coal and ash handling were segregated from those of the coal itself in published statistics.

Lamp Precautions

ONE important section of the Home Office Industrial Museum in London is that relating to industrial safety, a section which is given special mention in the May "Production and Engineering Bulletin." A series of photographs is reproduced of electrical appliances and accessories which have caused fatalities in and about industrial establishments. It is noteworthy that out of fourteen instances ten are faulty lamps or lampholders. It is probable that power appliances give the impression that care must be taken with them, while electric lamps are so simple and harmless-looking that precautions are considered hardly necessary. Whatever the reason may be those responsible for the safety of factory workers should impress upon their people that a 230-V shock is just as possible and just as bad with a handlamp as with a motor.

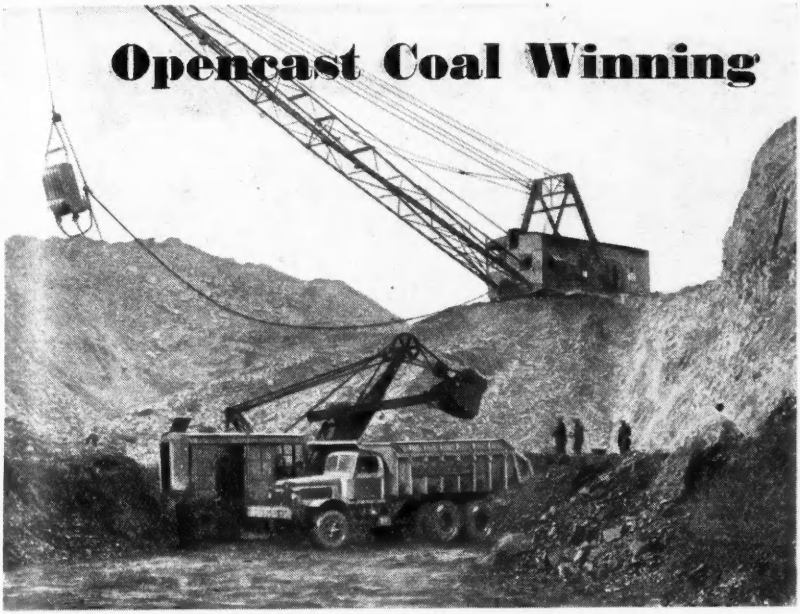
Free France

AT a recent meeting of the Institution of Electrical Engineers, the President, Sir Harry Railing, reported an exchange of greetings with the Société Française des Electriciens. Further evidence of the determination of our opposite numbers in France to take the position due to them in the Fourth Republic has come to us in the form of the Société's *Bulletin* for January, February and March, 1945. Principal contents relate to the work of M. G. Darrieus (who died early last year), electrolysis, fluorescent tubes, very-high-frequency heating, system stability, electromagnetic vibrations and X-rays, the last by the Société's new President, M. Hector Pilon. These publications are, we trust, harbingers of an early renewal of the former close personal relations between French and British electrical engineers.

Colonial Careers

MANY young engineers from this country now in the Forces are serving in the Colonies. To some, no doubt, who are ambitious to make headway in their professions the opportunities for establishing a career for themselves in those more undeveloped parts of the Empire will be attractive. The Colonial Office, which has just taken over the arrangements for the recruitment of engineers with professional qualifications from the Crown Agents for the Colonies, has prepared a memorandum which tells of the wide scope which exists and outlines the necessary qualities. Men are required whose bent is towards the creative and practical rather than the academic and who are possessed of a spirit of adventure. They should be prepared to take their share in the general development of the Colony in which they serve.

Opencast Coal Winning



ONE of the most outstanding industrial developments during the war years, of both general and electrical interest, is the winning of coal by opencast methods, *i.e.*, quarrying for the coal where the seams are comparatively near the ground surface. So that the new development may be seen in its correct perspective it must be said that this is not a serious challenge to the established method of coal mining, for coal does not exist near the surface in sufficient quantities. There may be other reasons as well, economic, for instance, but it is not the intention to discuss them in the present article.

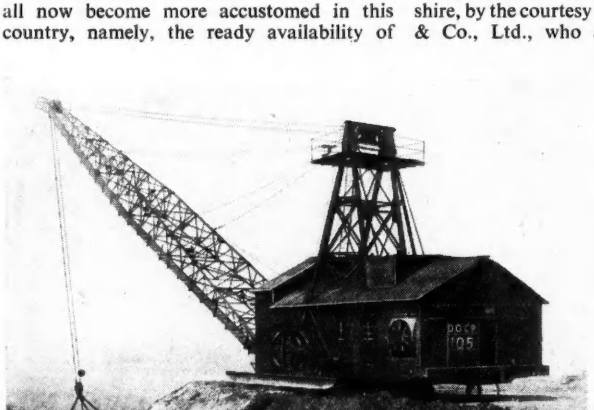
On the site referred to in this article, which incorporates part of the Barnsley coal seam, electrical consumption in a typical week amounts to 120,000 kWh

The few million tons of opencast coal produced in this country since 1942 when working was commenced by large civil engineering firms, under the direction of the Ministry of Works, are, however, a particularly useful supplementation of the coal produced by mining—about 250 million tons in peacetime. And it is reasonable to assume that the new development will continue during, at least, the earlier years of reconstruction. The main electrical interest of the development, however, lies in the advances which have been made since the work was started, particularly in the course of the past two years, in the efficiency of the site operations.

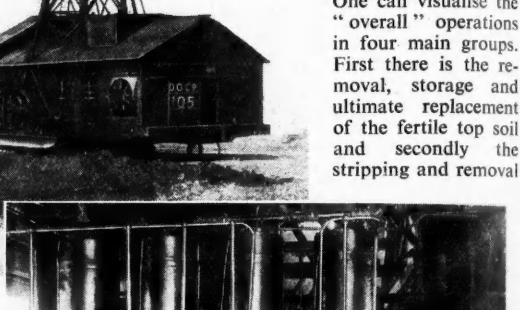
These advances have resulted from two major factors. First there is the influence of American general industrial production experience—" of doing bigger things in bigger ways " — which all right-minded men in this country now recognise and appreciate and are keen to take advantage of. In the earlier days all the work was carried out by means of excavating machinery which, in view of the tremendously large quantities of material which have to be handled, was comparatively small and unsuitable. Since then American engineers have come over to place their valuable experience in " strip mining " at the disposal of those engaged in the new development in this country. Further, a considerable quantity of American machinery for the unusual tasks has been brought here, and this has led the way to the production of

more suitable machinery at home. The second influence is one with which we have all now become more accustomed in this country, namely, the ready availability of

ments we recently visited the opencast coal-production site at Wentworth, Yorkshire, by the courtesy of Sir Lindsay Parkinson & Co., Ltd., who are responsible for the development of this particular site. Coal production actually began at Wentworth in February, 1944, although clearance and preliminary operations were started well before that time. One can visualise the "overall" operations in four main groups. First there is the removal, storage and ultimate replacement of the fertile top soil and secondly the stripping and removal

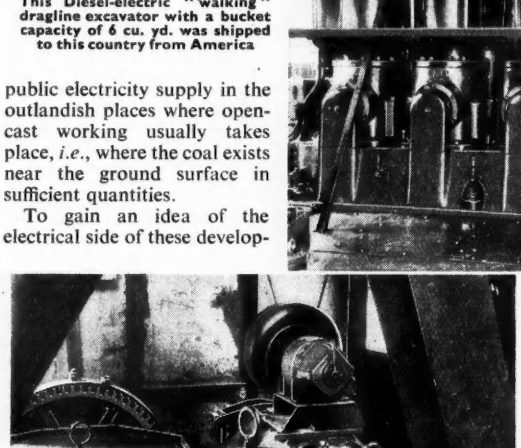


This Diesel-electric "walking" dragline excavator with a bucket capacity of 6 cu. yd. was shipped to this country from America



public electricity supply in the outlandish places where opencast working usually takes place, *i.e.*, where the coal exists near the ground surface in sufficient quantities.

To gain an idea of the electrical side of these develop-



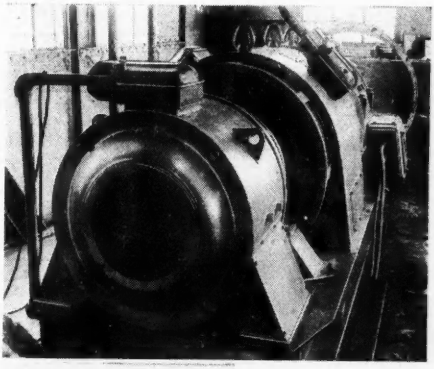
Above: The 280-HP, 300-RPM, four-cylinder engine on the Diesel-electric dragline excavator directly serves the travelling and dragline operations, and in addition drives a 75-kW DC generator which supplies the slewing motor
Left: The slewing motor of the excavator which is connected by pinion gearing to a crown wheel on a vertical shaft

of the material overlying the mineral seam. The third group of operations involves the digging, loading and removal of the exposed mineral, while fourthly there is the screening of the coal produced, after

which it is ready for dispatch in the required grades.

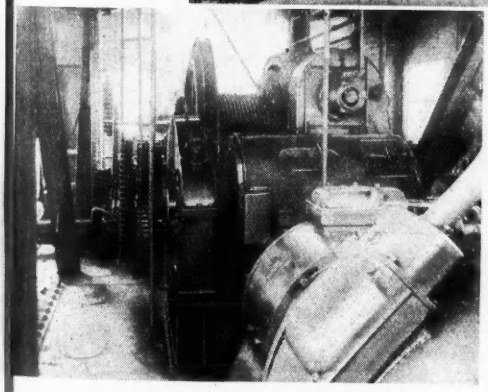
The removal, transport to and from storage dumps, and replacement of the top soil is done by high-power Diesel-engine-driven caterpillar tractors and scrapers which literally peel the turf and soil from the surface, mechanically load it into and from self-contained boxes and transport it to and from storage mounds.

The major electrical interest in the whole production scheme lies in the stripping of the overburden, for which a variety of very large Diesel-electric and all-electric excavators are employed. The site is worked in cuts, *i.e.*, huge trenches, which vary in depth up to 70 ft. to the bottom of the coal seams, which vary to a maximum of 20 ft. deep. A cut may be from 50 to 70 ft. wide, depending on the depth of the overburden, and up to a third of a mile long, depending on the site conditions. After the coal has been removed from one cut this is filled in with the overburden from the next and adjacent cut. The overburden at this site is mainly sandstone, and the rock face of the next unworked cut presented to a previously worked cut is first drilled and blasted in preparation for the actual excavation.



The m.g. set on the all-electric "walking" dragline excavator is a four-unit equipment with a 200-HP main motor, a 120-kW generator for hoisting and travelling, and two 40-kW generators for slewing

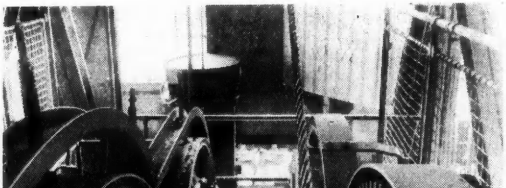
Right: A 5-cu. yd. walking type dragline excavator is "all-electric"



Below: Hoist and dragline 125-HP motor fitted with a separate motor-driven cooling fan

The normal method of excavating the loosened overburden is by means of a dragline excavator which digs, transports and dumps the material where required and is, in fact, a combined excavator and conveyor with a boom length which determines the distance of transportation. Where the overburden is too deep to permit the overall handling of the material by a particular dragline excavator,

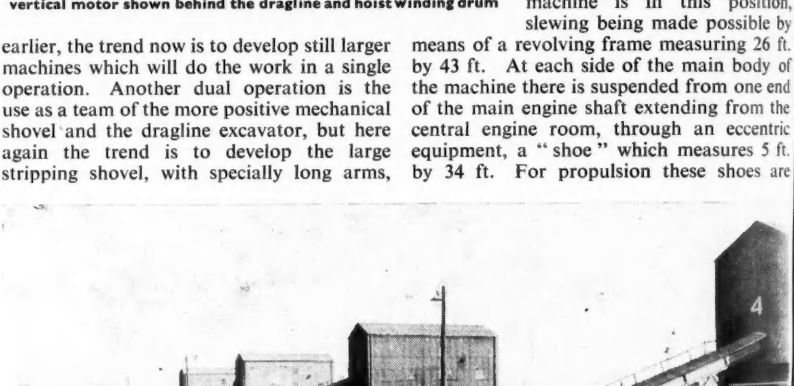
a second one is employed to rehandle the material cast over by the first excavator, but as the result of the influences referred to earlier, the trend now is to develop still larger machines which will do the work in a single operation. Another dual operation is the use as a team of the more positive mechanical shovel and the dragline excavator, but here again the trend is to develop the large stripping shovel, with specially long arms, which will also carry out the overall task in one operation.



Slewing of all-electric walking excavator is effected by the 40-HP vertical motor shown behind the dragline and hoist winding drum

Perhaps the most interesting dragline excavator on the job is one which was shipped from America and was, we believe, the forerunner of others of its special type, in that it is propelled by a " walking " motion. This excavator has a bucket capacity of six cubic yards and a boom 150 ft. long. It has an overall weight of 310 tons and goes through a complete cycle of operations from the initial bucket loading to the return of the bucket in less than one minute. This is a Diesel-electric equipment and the main Diesel engine, which directly propels the machine as a whole and serves the hoist and dragline equipment is a 280-HP four-cylinder set which operates at 300 RPM.

When standing, the complete machine rests on a heavy circular base or tub 30 ft. in diameter, and the actual excavating operations are effected when the machine is in this position, slewing being made possible by means of a revolving frame measuring 26 ft. by 43 ft. At each side of the main body of the machine there is suspended from one end of the main engine shaft extending from the central engine room, through an eccentric equipment, a " shoe " which measures 5 ft. by 34 ft. For propulsion these shoes are lowered and raised by means of the eccentrics, and when they are fully lowered they take the weight of the complete machine, including the base tub, which is carried forward or backward, as required and



Coal is conveyed from the face to five self-contained screening plants, four of which are shown

according to the direction of the engine, with the continued operation of the eccentrics, thus moving the complete dragline excavator forward or backward in 6-ft. "hops" and giving a continuous propelling speed of about 0·2 mile per hour.

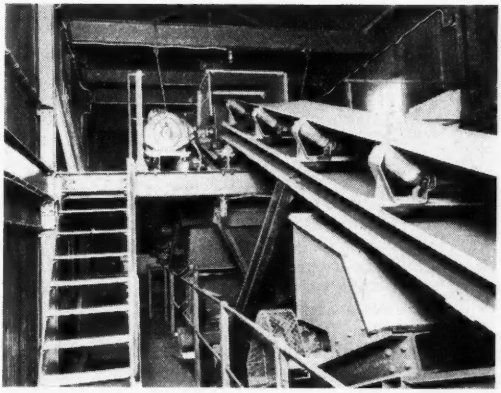
The hoist and dragline ropes operate round a hoist drum 32 in. in diameter and a dragline drum of 34 in. in diameter, and the hoisting speed is 168 ft. per minute. The slewing motion is electrically driven by means of a supply from a 75-kW, DC generator which is driven from the main engine shaft with a belt transmission scheme of 300 to 725 (actual) ratio. This generator is separately excited by a small unit carried on its shaft extension. The slewing motor is a 75-HP, 525-RPM machine which transmits power through pinion gearing to a crown wheel mounted on a vertical shaft which is directly responsible for the slewing operations.

As regards the excavating operations as a whole, the working area about the dragline excavator is illuminated for night working by means of five 500-W lamps secured to the dragline boom for downward projection. Because of the voltage variation required from the main generator for Ward-Leonard control of the slewing motor, a separate lighting generator is installed for the boom lamps. This 10-kW, 240-V machine is also driven from the main engine shaft.

All-Electric Excavators

Another dragline excavator which operates on the walking principle is a Ruston Bucyrus-Monaghan equipment with a 5-cu. yd. bucket capacity. This is an all-electric machine and it receives a supply from the workings distribution scheme at 3 kV, 3-phase, 50 cycles, by way of a trailing cable entering the rim of the base tub. The propelling motion is served by the 200-HP main motor of a m.g. set with three other units, namely, a 120-kW, 230-V generator which supplies the 125-HP, 460-RPM hoist motor and two (one at each end) 40-kW, 230-V generators serving the slewing motor. The hoist and dragline motor is forced-ventilated by means of a separate motor-driven cooling fan mounted upon the main unit. There is straight pinion-gear transmission to the winding drum. The motors are Ward-Leonard controlled.

The hoist and drag clutch band and all the brakes are compressed-air operated and controlled by solenoid valves which are switch controlled from the driver's platform.



Main conveyors on screening plants are operated by 20-HP motors

These valves are supplied from a separate 110-V exciter which serves the generators of the m.g. set, and the exciter and compressor motors are supplied at 400 V from a transformer which has 110-V tappings to provide for the lighting on the boom which is 135 ft. long.

A Ransomes & Rapier all-electric dragline equipment with caterpillar propulsion has a 2-cu. yd. bucket capacity. The hoist and dragline drums and the travelling motion are operated by a 60-HP, 230-V motor supplied from a 55-kW, DC generator, and the 23-HP slewing motor receives its supply from a 20-kW, DC generator. These two generators, together with a third generator which is provided for a crowd shovel motor in the event of the machine-operation method being altered, are components of a m.g. set which has a main 100-HP, 3·3-kV motor drive. The scheme embraces the Ward-Leonard system of control.

The main motor is directly supplied and a 400-V transformer with 110-V tappings supplies the exciter motor for the m.g. set and thruster motors on the hoist and dragline clutch bands, and the lighting fittings on the boom, which is 85 ft. long. While the average demand for this machine in service

is about 60 kW, a peak demand of about 200 kW, of about two seconds' duration, occurs in practically every working cycle. A Ruston-Bucyrus dragline excavator with caterpillar propulsion is similar in most respects to the equipment last described, except that the clutch bands are compressed-air operated, with switeh and solenoid control, and that the lighting is at 110 V, 3-phase.

A Ransomes and Rapier crowd shovel with a bucket capacity of 3½ cu. yd. is caterpillar propelled. Its main equipment embraces a Ward-Leonard m.g. set with a 200-HP 3·3-kV main motor, a 120-kW 230-V generator serving the 125-HP hoist and travelling motor, a 31-kW generator the 40-HP slewing motor, and a 31-kW generator the 40-HP racking motor. Thruster motor braking is employed for the hoist, while the slewing and the racking motors are served by solenoid-operated brakes. Most of the driving motors and switchgear on the all-electric excavators are of B.T.H. production, and the transformers were made by Johnson & Phillips.

Removal of Coal

After the overburden has been removed, the top surface of the coal seam is cleared by bulldozers and the coal is then removed by means of Diesel-engine-driven crowd shovels which operate directly on the complete coal face and load directly into waiting lorries which transmit the coal to the screening plant. There are some extremely large Diesel-engine-driven road vehicles (" Mack " transporters) for carrying the coal. These are of American production and will accommodate up to 20 tons each. Their steering gear is hydraulically operated.

For the screening operations there are five self-contained plants, each complete with a conveyor system from the coal inlet at ground level to the outlets from the elevated enclosed screening plant proper. In each case the filled lorries or transporters from the coal face deliver their loads into a below-ground hopper through a grid at ground level. In a pit which houses the hopper is the lower end of the main coal-delivery belt conveyor to which the coal is fed by a motor-driven shaker feeder. This main conveyor, which is about 40 ft. long, raises the coal to a point about 15 ft. above ground level and inside the screen enclosure, where it feeds a mechanical-shaker screen with a 2-in. grid. The by-passed coal from this screen is carried on to another conveyor running at right-angles to the main conveyor to the large-coal delivery outlet. The smaller coal passed by the screen falls on to a third conveyor immediately under the main conveyor and running in the opposite direction to the small coal-outlet delivery chute.

The main conveyor is driven by a 20-HP 720-RPM Brush motor with transmission first through a Crofts reduction gear with a ratio of 722 to 24, and then directly to the shaft of the top end drum of the conveyor. The shaker screen is driven by a 10-HP 715-RPM English Electric motor with V-belt transmission to the central shaft on the shaker equipment in which the shaking motion is produced by an eccentric. The small-coal conveyor is operated by a 7½-HP 720-RPM Brook motor with transmission similar to that of the main-coal conveyor, *i.e.*, a 720 to 24 ratio reducing gear. A practically identical driving scheme exists for the large-coal conveyor.

Each screening unit has a total capacity of 150 tons per hour. The output of the electrical portion of the site is estimated at about 12,000 tons per week, and the consumption for a typical week for the whole site, including the screening, is 120,000 kWh. Over a million tons of coal are available at this site, which incorporates a part of the famous Barnsley coal seam.

We are indebted to Mr. I. W. G. Freeman, chief agent to Sir Lindsay Parkinson & Co., Ltd., and to his staff, for their help in collecting the above information and in taking photographs.

French Railway Electrification

ALTHOUGH the electrification of the French railway network was retarded by the war, progress has been made on the Sete–Nimes, Paris–Lyons, and Bordeaux–Montauban lines. The Sete–Nimes line is an extension of the electrification of the old Midi line. There is still 80 km. to be completed. The most important line, however, is the long Paris–Lyons route, which carries the heaviest traffic in the country. Final plans have been made and the work will be started shortly. The rolling stock for the line is already being built. It does not differ appreciably from that used on the Mans and Bordeaux lines, excepting that the locomotives will be more powerful. The weight per driving axle, for example, has been raised from 20 to 23 tons. The goods locomotives will total 2,400 HP, against 1,850 on other lines, and passenger locomotives will be of 4,000 HP.

Watt-hour Meters

Methods of Compensating for Temperature Errors

By O. G. W. Davis,
Associate I.E.E.

THERE is no need to emphasise the necessity for the performance of a meter to remain unchanged with variation of seasonal shade temperature which, even in Britain, extends over an extreme range of 90 deg. F. In the experience of the Hampstead Borough Council's Electricity Department some alleviation results from thermostatic control of room temperature and so its test room is maintained at 15 deg. C. Thus the need for calibration allowances is obviated and variation of accuracy is reduced when testing uncompensated meters, but there still remains the lengthy "warm-up" period, while it is impossible properly to estimate allowances suitable for calibrating instruments subject to abnormal service conditions, *e.g.* in a boiler house or laundry.

Compensating devices, which are certain to assume increasing importance, were introduced as early as 1930 for test models, but were not applied to ordinary commercial grade meters until after the passage of the Electricity Supply (Meters) Act, 1936.

The rotational speed of an uncompensated AC watt-hour meter increases with temperature on loads of unity power factor and decreases on inductive loads of lagging p.f.

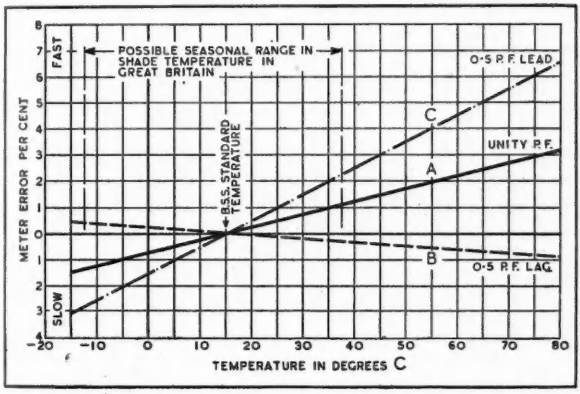


Fig. 1—Variation of error with temperature of uncompensated single-phase meter

The temperature coefficient, meaning the percentage increment of registration per degree C., varies between different makes and types, but in the case of modern patterns (Clause 39, B.S. 37–1937) it does not exceed 0·1 per cent. per deg. C. at unity or 0·5 agging p.f.

Equal increments of temperature cause equal increments of registration (Fig. 1) over the whole temperature range, which covers all normal operating conditions and can be shown by experiment to remain true for all practical purposes at all loads. The actual variation of the temperature coefficient over the whole load range will never exceed, and is usually less than, ± 10 per cent. of its own mean value and, therefore, can be ignored. These facts greatly simplify compensation, since they permit the application of devices which are equally effective over the whole normal load and temperature ranges. The ideal compensating device (Fig. 1) would bring curve A as nearly as possible to the horizontal and make the angles between curves A and B, and A and C, as small as possible.

Mr. Davis is meter superintendent with Hampstead Borough Council

Assuming that a rise in temperature has occurred, expansion of the framework of the meter parts may cause changes in their relative positions and produce a positive, zero, or negative effect on the registration, depending on design. No general statement can be made which would be valid for all types and makes.

The voltage element will be affected by the resistance of the copper coil increasing (0·4 per cent. per deg. C.) this being accompanied by a relatively small decrease of inductance. In this way the current in the winding decreases and the reduction of its phase angle causes the meter to slow up on all power factors. The permeability of the core remains practically unchanged and, since the total reluctance of the magnetic paths is largely made up of

air gaps which are unaffected, the change in voltage flux will be negligible.

The main current element is controlled by load and cannot vary. Negligible change occurs in core permeability; therefore, no temperature effect is apparent.

The rotor disc resistance will increase and the inductance will slightly decrease, causing a decrease in magnitude of the eddy currents and a slight reduction of their phase angle lag. This has two effects. In respect of that part of the disc moving in the electro-magnet gap, there is decreased registration at all p.f., whereas in that part moving in the brake-magnet gap there is increased registration at all p.f. The two tend to

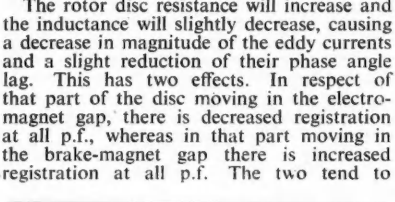


Fig. 2—Alloy flux-shunting device

offset one another and the total effect is of a minor order. The brake magnet flux passing through the disc will decrease and there will be increased registration at all p.f.

A light load compensator of the magnetic type comprises a soft iron member which permits controlled shift in the distribution of the voltage flux; it experiences no change due to temperature. In the shading vane type with adjustable copper or aluminium vanes there will be decreased registration at all p.f. due to the increase in resistance. The effect, however, is only of a minor order since the compensating torque represents only a small fraction of the main driving torque, even at 5 per cent. load.

With the quadrature compensator the resistance of the loop increases with resultant decrease of current and compensating flux. The meter will run slow at lagging p.f., with zero effect at leading p.f. near unity, and fast at lower leading p.f.

This analysis shows that the various effects of temperature may be resolved into two groups. In the first fall those which, for a fixed increment of temperature, are sources of fixed increments of error at all p.f., whereas in the second group fall those which only give rise to errors at p.f. other than unity, the magnitude of the latter errors being relative to the phase angle. This group is confined solely to the quadrature compensator.

The total effect on a meter will be the algebraic sum of all the errors, some happily offsetting others. Thus, by accident or design, it is possible to have a combination in an uncompensated meter resulting in a low temperature coefficient for either unity or for lagging power factor, or possibly a compromise between the two. In any event there is bound to be an unavoidable difference between them.

The problem of compensation then resolves itself into the design of controllable devices for reducing, or eliminating if possible, the total effect of temperature change on a meter's performance. When applied to any of the components within the first group, they may have the desired effect at unity p.f., but they will at the same time affect the co-efficient for all other power factors in the same direction and to the same degree. Thus, if curve A (Fig. 1) is turned down to the horizontal position, curves B and C will turn with it, maintaining the same angular disposition with respect to A. Additional and independent means must, therefore, be sought to bring the B and C curves as nearly as possible to the horizontal. It is possible to do this by suitable modification of the component in the second group, the quadrature compensator, or lag winding, since it is affected by temperature only at p.f. other than unity.

To summarise, compensation can be divided into Class A for unity power factor loads and Class B for inductive loads. The first counteracts the effect of temperature variation on the field strength of the brake magnet, or, alternatively, of the driving torque; the second controls the angle of the quadrature compensating flux. The methods used to achieve this in practice are briefly described.

For Class A compensation a mechanical method has been devised whereby a bi-metal member may move the brake magnet radially to the disc, or a similar type moves a magnetic shunting bar in the magnet gap. The effect is to control the magnet flux, so that with

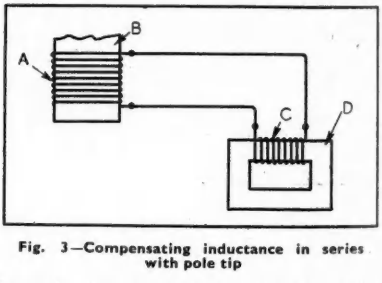


Fig. 3—Compensating inductance in series with pole tip

increasing temperature the proportion cutting the disc is increased and rotor speed decreased. Mechanical devices have the disadvantage of being unstable and the better and more usual method is to use a

flux shunting device made of some temperature sensitive material. There are various arrangements; in one of them, Fig. 2, the soft iron member A is permanently across the poles of magnet B, adjacent to the path of disc C. It is separated from the poles by distance pieces D′ D′ made of a special alloy which has the property of varying its permeability with temperature. Normally the permeability is quite low and it decreases with increase of temperature. Since the leakage flux traversing the shunting bar is parallel to the main flux, any tendency for the latter to weaken with increasing temperature can be counteracted by a proportionally larger decrease of the leakage flux. By suitable arrangement the main flux can be kept at a constant value and hence the disc speed will also be constant. It should be noted that while this device is concerned with the brake magnet, it is not intended only to correct for the varying flux of that member. Actually it corrects for the combination of all the errors arising from components in the first group.

Another method controls the driving torque. A lamination of the same alloy is embodied in the core of either of the driving elements and has the effect of reducing the flux cutting the disc when temperature rises, due to its increased reluctance.

Variable Inductance Method

Class B compensation consists essentially of an inductance, the value of which varies with change in temperature. Inductance C having a core of temperature-sensitive material D (Fig. 3) is connected in series with the lag compensating turns A on pole tip B of the voltage element. The current in the lag winding traverses the coil C, its magnitude being dependent on the inductance and hence on the permeability of the special core. Now when the temperature increases and the potential flux of the voltage coil becomes under-compensated at lagging power factor the meter would normally run slow. However, as the permeability of the special core decreases the impedance in the lag circuit is lessened and allows a larger current to flow. The potential flux is thus compensated and the meter is caused to run at the correct speed.

The special alloy mentioned in the preceding paragraphs may be chosen from the class known as "thermo-magnetic" materials. In general they have patented constitutions and are known by trade names. That specified as "Jae" metal (Fig. 4) is composed of 69·5–70·6 per cent. nickel, 0·3 per cent. max. iron, 0·1 per cent. max. carbon and the balance copper. The permeability is very low, being about 120 at 15 deg. C. for a magnetising force H = 5 and decreasing to about 12 for H = 100. ("Stalloy," by comparison, has a permeability of about 3,000 for H = 5.) Its reluctance increases with rising temperature, approximately doubling for a rise of 20 deg. C. Over the operating range of temperature the curve follows a straight line law sufficiently closely to allow equal compensation at different temperature levels, since the alloy is required to deal with only a small fraction of the total flux whether from the permanent magnet or the electro-magnets. Thus by a suitable combination of the two classes of compensation it is possible to correct for varying temperatures at all loads. The amount of success achieved depends on

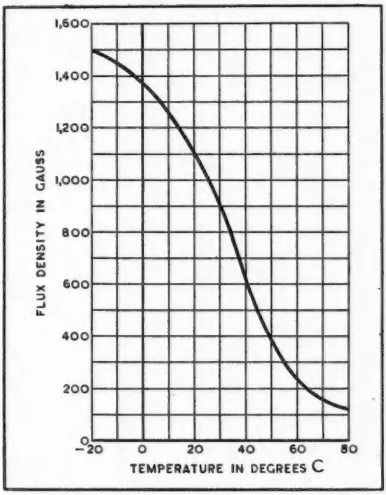


Fig. 4—Variation of "Jae" metal flux density with temperature (for magnetising force equivalent to H = 100)

design and adjustment; because a meter is temperature compensated, it does not necessarily follow that it will be free from errors. It should be remembered that the compensators have a definite time lag and cannot readily respond to rapid changes in temperature. This is unavoidable, since considerable masses of metal are involved.

The assistance of Mr. H. Brierley, borough electrical engineer and manager, Hampstead, is acknowledged in the preparation of this article.

Silver Jubilee Outing

To celebrate their silver jubilee and the end of the war in Europe, Hirst, Ibbetson & Taylor, Ltd., are arranging a day in Southport for their staff and friends, including an informal luncheon and dinner at the Belle Vue Hotel, on June 20th.

Views on the News

Reflections on Current Topics

IN the lift engineering business there are many dangers and (literally) pitfalls which the apprentice to the trade can discover by precept or experience. The latter method is likely to prove painful or fatal and so precept is to be preferred. For this reason I welcome a little booklet which Marryat & Place, Ltd., have produced as a guide to their apprentices. In this (" Take the Right Road ") the mechanical and electrical hazards to be encountered and the precautions to be taken are enumerated in a simple, practical fashion. The last few pages are in a lighter vein. They contain little sketches of the dire —even gruesome—consequences of carelessness or (what is perhaps worse) over-cleverness. An impression may be given that the lift engineer's life yields more kicks and shocks than ha'pence but the fact that there are lift engineers in being means that some at least survive their apprenticeship and these must be the very fittest.

* * *

Whatever views electrical contractors and retailers have about Government control they will certainly hope that the regulation imposed by the Location of Retail Businesses Order will not be relaxed for some time. The willingness of the public to take any sort of appliances at any prices is bound to attract to the electrical appliance retailing business many quick-profit snatchers whose interest in the appliances they sell disappears with the sale. Such business is injurious both to the established seller of electrical goods and to the reputation of electricity. I see from the *Electrical World* that in the United States the same sort of thing is feared. They have a name for those who are more enterprising than reliable—" in-and-outers." In their case it is considered the duty of the electrical utility to protect the purchaser against inferior products and deceptive sales methods.

* * *

Though I strongly favour a standard form of electricity tariff and think that a lot of ingenuity is put to a perverted use inventing novel systems of charging, there do seem exceptional cases in which there may be something to be said for offering special rates for the encouragement of some new application of electricity. I came across a case in point when visiting Tyneside a few days ago. When Pyrotenax, Ltd., opened its factory for making mineral-insulated cables at Hebburn in 1937 the processes involved were to some extent untried and the characteristics of the load, if all-electric, could not be determined sufficiently to ensure that any normal tariff would be suitable. Instead, therefore, of a maximum-demand charge, the North-Eastern Electric Supply Co., Ltd., offered temporarily to charge a sum based on the output of the product, together with a very low rate per unit, and two years later, when the load was established and the methods of working satisfactorily evolved, a normal type of tariff was agreed and has been in operation ever since. But for this scheme the heat treatment would almost certainly not have been carried out electrically, a load of 600 kW would have been lost to the supply undertaking, and possibly the development of the cables might not have proceeded so successfully. It is now proposed to increase considerably the output of the factory, which will, of course, mean a very considerable further use of electricity.

* * *

Among the many developments held up by the war was the Gillott electro-steam cooker described in the *Electrical Review* of February 9th, 1940, which was claimed to be capable of meeting all the cooking and water heating requirements of the home. I was reminded of this by Viscount Elibank's statement last week that the Southern Areas Electric Corporation, Ltd., had acquired a controlling interest in Gillott Electro-Steam Cookers, Ltd., and I had a word with the designer, Mr. W. A. Gillott, who is very well known in the industry. He tells me that during the war he has been concentrating on the production of immersion heaters but his company will shortly be in a position to turn out electro-steam cookers embodying improvements on the 1940 model which can be regarded as a prototype.

* * *

Although the model which was described in the article referred to above was designed for domestic use it was stated at the time that larger sizes were in prospect. From a talk with the Southern Areas Corporation I gather that, although complete plans have not been made, it is likely that these larger sizes (for hotels and such establishments) will be dealt in at first. The Corporation's support should secure a footing for the new appliances—a difficult matter for most novel departures. I am reminded by this last consideration of the heat-storage cooker which has many good points but has never secured favour here. Electricity has a good deal of conservatism to overcome before it can reach its greatest heights.—**REFLECTOR.**

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Factory Organisation

IT was with very mixed feelings that I read in your issue of May 18th the review of my first book, "Factory Organisation and Management." On the whole, I am rather grateful to your reviewer for treating me with so much kindness. I only hope he will feel that the second edition, which is to follow hard on the heels of the first, is an improvement.

I notice he accuses me of ambiguity and unusaul grammatical expressions, but I must say I do not think it was very fair of him to misquote me. I was also disappointed to find that he considers my treatment of budgetary control too theoretical. This is precisely the accusation I have always levelled at other books, but this time I flattered myself the reader would be well served. I set out to give, in complete detail, the system which I have used with success for many years.

It was also rather unfortunate that he should say "the examples of wage rates, *i.e.*, 1s. per hour for an operative, are some years behind." Where I quoted labour rates I was most careful to employ the Federation figure ruling at the time, although, owing to the many months the book was in the hands of the printers, these rates are to-day slightly out-of-date. As a matter of fact, I had half a mind to use purely arbitrary figures for the sake of simplicity and it was in anticipation of this criticism that I decided in favour of Federation rates.

N. F. T. SAUNDERS,
Wembley. B.SC., M.I.E.E., F.C.I.S.

Industrial Lighting

WARTIME experience of fluorescent mercury-vapour lighting in the drawing office, general offices and some parts of the works of one of the largest factories in the Midlands has been that, compared with tungsten lamps, the new lighting seemed first of all too much of a white glare, giving the impression of being outdoors in the summer. After some weeks one got used to this floodlight effect, but other peculiarities manifested themselves.

First, it was found that pencil drawings were more difficult to see, as the white light had a fading effect, dark lines becoming grey, even disappearing owing to reflection from so many different angles. Another trouble was caused by backlight throwing a thin shadow line along the edge of a T-square. This was cured by fixing paper-shade strips along the edge of the lamp cases behind the sitter.

The lamps were arranged in numerous rows about 6 ft. apart parallel to the rows of drawing boards. This is not the correct way according to the rules for studio lighting, which insist that daylight should come from the left. The rows of lamps should, in my view, have been placed at right angles to the boards.

Blue prints on the other hand showed up remarkably well but faded if left uncovered too long. Black and white prints and tracings showed up quite well, but anything with a shiny surface reflected badly.

The effect in machine shops and works, previously badly lighted, has been excellent and there has been no adverse criticism, as conditions of work are unlike those in the drawing office. The average effective life of the fluorescent tubes was six months, after which a marked decrease in candle-power was apparent. Need for lamp replacement was indicated by flickering. Renewal costs compare favourably with those for metal filament lamp installations.

The best effect is obtained by placing the lamps at a height of approximately 16 ft. from the ground. Little heat is given off and no eyestrain is felt when looking direct at the lamp. Generally speaking, fluorescent light is a vast improvement on older systems if the troubles outlined can be mastered by intelligent planning and arrangement of the lamp lines.

Birmingham, 5. C. E. S. LANE.

Too Many Catalogue Sizes

IN your issue of May 4th a correspondent makes a plea for the standardisation of the sizes of catalogues and similar engineering publicity matter. It may therefore be of interest to many of your readers to know that, at the request of the Royal Institute of British Architects, a committee has been set up by the British Standards Institution to consider the standardisation of the sizes of sales literature issued by manufacturers connected with the building industry. The recommendations to be made in due course will, it is hoped, remove the source of irritation to which architects and others have been subjected due to the multiplicity of sizes of the sales literature which come to their attention.

Should there be a clearly defined need, the terms of reference of this committee could be widened to cover sales literature applicable to the engineering industry as a whole.

*London, S.W.*1. P. GOOD,
Director, British Standards Institution.

Magnetic Materials

Sir Lawrence Bragg's Views

IN the annual lecture to the Measurements Section of the I.E.E. last Friday Sir Lawrence Bragg (Cavendish Professor of Physics, University of Cambridge) dealt with the scientific development of magnetic materials. Sir Harry Railing (President) was present at the meeting, over which Mr. W. G. Radley (chairman of the Section) presided.

SIR LAWRENCE BRAGG suggested that the whole field of magnetic materials was one in which pure and applied science should collaborate to place this country in a stronger position. He had been told that other people had got ahead of us in the making of good transformer steel and that they could make it with a lower hysteresis loss than we could. Regarding permanent magnets he did not see why the great " brainwaves " of the last twenty years or so should have come from Japan, of all places. One could trace the enormous development of electronics in America to the fact that O. W. Richardson went there a generation ago; perhaps the reason why Japan, with no very great scientific achievements to her credit, had yet produced exciting new magnetic materials was that Ewing went to Japan some forty years ago as a professor at the Imperial University.

Effects of Orientation

Sir Lawrence went on to discuss the theory of magnetism, to show the lines along which one might effect improvement and those on which nature had set a barrier. He referred briefly to the theories of the orientation of the molecular magnets and said the difference between a para-magnetic and a ferro-magnetic body was not that one had weak and the other had strong molecular magnets. It was that in a para-magnetic body the magnets were not subject to discipline, but pointed in all directions, and that a field applied to them would turn them only slowly, although if one made the field strong enough one would arrive at something approaching the ferro-magnet; whereas in the ferro-magnetic body the molecular magnets were an extraordinarily docile crowd waiting to be given a tip as to where to point.

Which of the fundamental properties could be altered and which could not. Saturation was not influenced by the " geography " of the crystal. The elementary magnet was a property of the nature of the metal as a whole and, except within rather rigid limits set by nature, one could not do anything better than iron or cobalt, which had high saturation values, nickel having rather less.

As to remanence, one could not do very much; it depended on the distribution of the easy axes. For instance, in cobalt, which had one easy and one bad axis, by applying a field one could swing the elementary magnets into line. When the field was removed the best that could happen was that the magnets would all go back to the hexagonal axis. The remanence would be 0·5 of the saturation. In iron there were three cube edges and one of them was fairly sure to be in the direction required. If they all remained in the best direction, there would be about 0·83 of the saturation left as remanence; and for nickel it was about 0·86. At any rate, one would get some 20 or 30 per cent. less than the saturation as remanence. The Curie point was another property it was very difficult to alter.

Initial Permeability

Theoretically there was no reason why initial permeability should not be infinite giving the condition where the magnetic field would completely turn over all the elementary magnets. The reluctance to change the direction of the magnets was due to strains which occurred as the body cooled. The way in which to achieve very high initial permeability was to arrive at something with no magneto-striction, so that the strains were not locked up in the body when it cooled.

As to coercivity, there was no reason why a body should not hang on to all the magnetism remanent in it when the field was removed. That ideal had never been achieved, but we could go a long way towards it. The figure of merit (coercivity × remanence) of permanent magnets had been improved in recent years by an enormous factor; indeed, he had a magnet which would fit into his waistcoat pocket and would lift half a hundredweight.

In an ideal world there was no reason why there should be a hysteresis loop, or any energy wasted. Enormous improvement had in fact been achieved in that direction. Thus, the three factors which had been improved (initial permeability, coercivity and hysteresis loss) were just those in respect of which there were no natural limits.

Indicating some of the ways in which those problems were being attacked on the theoretical side, Sir Lawrence mentioned some fundamental work on transformer sheet steel which had been undertaken at the request of the E.R.A. In the field of magnetic materials there could be very good collaboration between pure science laboratories and those who needed the materials for various purposes.

PERSONAL and SOCIAL

News of Men and Women of the Industry

IT was announced in the annual report for 1944 of the Institution of Electrical Engineers that a committee was being set up to advise the Council on matters connected with electrical research which affect the Institution, to assist in the selection of Institution representatives on external bodies connected with research, to help such representatives and when necessary to provide liaison between them and the Council on matters of policy. The members of the new Research Committee are the President (*ex officio*), Dr. P. Dunsheath (chairman), Sir Arthur Fleming, Mr. T. E. Goldup, Mr. P. V. Hunter, Mr. H. L. Kirke, Mr. C. W. Marshall, Dr. C. C. Paterson, Dr. W. G. Radley and Mr. R. S. J. Spilsbury.

Mr. Forbes Jackson has been nominated as the I.E.E. representative on the Registration Board of the N.R.E.I.C. in the place of **Mr. W. R. Rawlings,** whose term of service has expired.

The Professional Engineers' Appointments Bureau is inviting applications from corporate members of the Institutions of Civil, Electrical and Mechanical Engineers for the post of secretary to the Bureau. Particulars can be obtained from the acting secretary, 8, Princes Street, London, S.W.1.

The Institute of Fuel has awarded the Melchett Medal for 1945 to **Professor C. H. Lander,** C.B.E., for his work in connection with fuel during the past thirty years. During the war he has turned his efforts, in collaboration with others, to many further developments, some of which he may be permitted to speak about when giving his Melchett Lecture in October next.

Mr. W. R. Elliott, Secretary to the Council of the British Electrical and Allied Industries Research Association, has sent us a photograph received from his son, **Lieut.-Col. N. R. Elliott,** showing the headquarters staff of the 163 Command Royal Engineers (Power), 21st Army Group, B.L.A., who are responsible for the electric power work for the 21st Army Group. Lieut.-Col. Elliott is in command and is seen in the centre of the front row wearing a service cap. It will be recalled that Lieut.-Col. Elliott, who was borough electrical engineer of Gravesend, was recently appointed to succeed Mr. A. E. McKenzie as "chief" at Wimbledon and is to take up duties there at a later date.

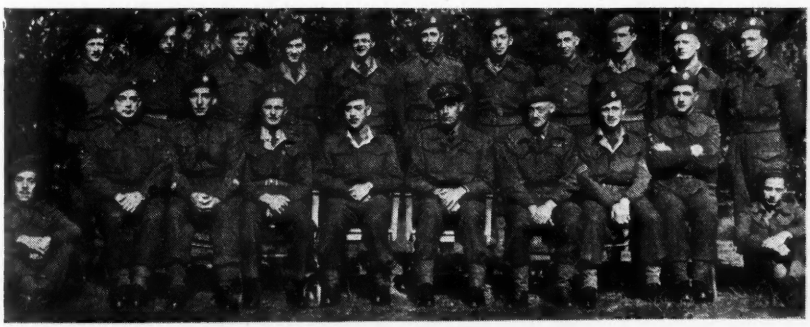
Upon his release from a German prisoner of war camp, it has been announced that **Flying Officer Dennis Perrin** has been awarded the D.F.C. After completing over forty operational flights he was shot down over Germany in January, 1944, when serving in a "Pathfinder" squadron. F/O Perrin was on the works office staff of George Ellison, Ltd., and was one of the first members of the Ellison Company Home Guard. The official citation states that the award of the D.F.C. has been made for the utmost fortitude, courage and devotion to duty during numerous operations against the enemy.

Flying Officer D. Perrin, D.F.C.

Major B. G. Drummond, jun., T.D., A.M.I.E.E., R.E.M.E., after having commanded a field workshop in N.W. Europe has been appointed D.A.D.M.E., H.Q., 30th Corps, B.L.A.

Mr. S. H. Mortensen, chief electrical engineer of the Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, has been awarded the 1944 Lamme Medal of the American Institute of Electrical Engineers "for his pioneer work in the development of self-starting synchronous motors and for his contributions to the development of large hydraulic and steam-turbine driven generators."

In spite of the prevailing difficulties, the Metrovick Dramatic and Operatic Society has presented several full-scale plays in recent times



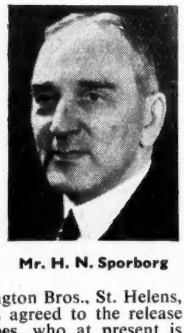
The headquarters staff of the 163 Command Royal Engineers (Power), 21st Army Group

and has just completed nine performances of the well-known musical play, "1066 and All That." With its twenty-four scenes, elaborate costumes, large cast and full orchestra complications, this production is claimed to be somewhat of a record for an amateur company.

Mr. O. G. Cook, chief electrical engineer and manager to the Bingley Urban District Council, has been elected vice-chairman of the I.M.E.A. Mid-East England Centre. As already reported, **Councillor C. A. Goodall,** chairman of the Leeds Electricity Committee, is chairman.

Mr. F. H. Williams, B.Sc. Tech., M.Inst.C.E., M.I.E.E., manager of the Galloway Water Power Co. since it first started operating, has been elected a director of the company. He will continue to hold the position of manager.

Mr. H. N. Sporborg is retiring at the end of June from the position of chairman of the board of directors of the British Thomson-Houston Co., Ltd., after completing forty-three years' service with the company.



Mr. H. N. Sporborg

Mr. Sporborg is also retiring from the positions of vice-chairman of Associated Electrical Industries, Ltd., chairman of the Cosmos Manufacturing Co., Ltd., chairman of Lamp Caps, Ltd., director of the Metropolitan-Vickers Electrical Co., Ltd., and director of the Switchgear Testing Co., Ltd.

At the request of Pilkington Bros., St. Helens, Mr. Oliver Lyttelton has agreed to the release of **Mr. Lewis J. B. Forbes,** who at present is Regional Controller of the Ministry of Production in Scotland and chairman of the Scottish Regional Board. Mr. Forbes will leave at the end of May.

Mr. W. F. F. Martin-Hurst has resigned from the board of the British Thermostat Co., Ltd., on his appointment as chairman and managing director of Teddington Controls, Ltd., a subsidiary company.

An exhibition of some of the latest electrical devices, electric cooking demonstration by Miss Eaves, London, and lighting demonstrations, were among the features of Dundee Civic Week. A lecture on "Television" was given by Mr. E. Allan, Dundee, and on "The Lighting of the Future" by Mr. J. Gavin, Glasgow.

Mr. H. S. Allpress, A.M.I.E.E., F.I.E.S., has rejoined the London branch of the Simplex Electric Co., Ltd. He will be responsible for the industrial and traction supplies department. During the war years he has served in the Ministry of Supply in the office of the Principal Lighting and Power Officer.

Mr. F. T. D. Meares, manager of the Mechanical Plant Department of Noyes Bros. (Sydney), Ltd., is arriving in England at the end of this month for a three-months' visit. While he is here he is to discuss the development of trading relationships with mechanical and electrical plant manufacturers and he would like to meet others interested in the Australian market. Communications may be sent to him c/o Bank of New South Wales, 47, Berkeley Square, W.1.

Mr. James Morey, a departmental manager with the Electric Construction Co., Ltd., who has been in the service of the company for forty-two years, has been presented with a set of tubular chairs and a framed photograph of the subscribers on his recent retirement.

Obituary

Sergeant-Pilot R. H. Davies.—We are very sorry to hear from Mr. J. H. Davies, district manager of the Shropshire, Worcestershire & Staffordshire Electric Power Co., that his only son, Sergeant-Pilot R. H. Davies, of a fighter squadron, is presumed to have lost his life in an air operation in Jugoslavia. He was twenty-two.

Sir Rayner Barker, whose death occurred on May 14th at the age of eighty-six, was educated at the Royal Indian Engineering College, Coopers Hill; in 1879 he joined the Indian Telegraph Department and was transferred to the Indo-European Telegraph Department in 1896 as engineer and electrician. Two years later he became director of the Persian section and when he retired in 1912 was made director-in-chief of Indo-European Telegraphs at the India Office, finally retiring in 1923. He was appointed C.I.E. in 1889 and knighted upon his retirement.

Mr. E. M. Pearson, A.M.I.E.E., deputy city electrical engineer of York, whose death we reported last week, was educated at Archbishop Holgate's Grammar School, York, and was trained in the York Corporation Electricity Department, after which he occupied posts in the Electricity Departments of Stockton, Coventry, Fulham, Stepney and Lancaster. In 1925 he rejoined the York Corporation and was appointed deputy city electrical engineer a few years later. He was sixty-one.

Mr. W. R. S. Careless, whose death in Toronto is reported, was educated at Faraday House and went to Canada in 1913. For the past five years he had been production inspector for the Dominion Department of Munitions and Supply. From 1928 to 1936 he was sales engineer with the English Electric Co. of Canada.

Mr. W. A. Rudd, northern divisional manager of Hoover, Ltd., died suddenly on April 27th, at the age of sixty-two. Mr. Rudd joined the Hoover organisation in 1927. He went to the north, with headquarters in Leeds, in 1935. For some time during the war in addition to his other duties he directed a small dispersal factory there.

I.E.E. Measurements Group

THE Council of the Institution of Electrical Engineers has sanctioned the formation of a Measurements Group in the North-Western Centre. An informal meeting is to be held on May 30th at the Engineers' Club, Manchester (5.30 p.m.), with the object of acquainting members with the facilities offered and to ensure that nominations will be available for the election of officers and committee of the Group. Radio and Installations Groups have already been established by the N.W. Centre.

Unbalanced Resistance Star Network

Proofs of the Graphical Solution

By R. L. Russell,
M.Sc., Graduate I.E.E.

THE graphical construction for finding the phase voltages in an unbalanced resistance star network when connected to a balanced three-phase voltage supply, while much simpler than in the general case of the unequal impedance star is not of the type usually encountered in such problems, and the electrical significance of the operations involved is not obvious.

An equilateral triangle A_1 B_2 C_3 is drawn to scale to represent the balanced line voltages as in Fig. 1. If the resistances of the network are R_1, R_2, and R_3 and A_1 B_2 is divided in the ratio R_1 : R_2 at N, B_2 C_3 in the ratio R_2 : R_3 at L, and C_3 A_1 in the ratio R_3 : R_1 at M, then the lines A_1 L, B_2 M, and C_3 N will be found to meet in a point O. This last result is capable of theoretical proof and is often referred to in plane geometry as Ceva's Theorem. The phase voltages across R_1, R_2, and R_3 are then

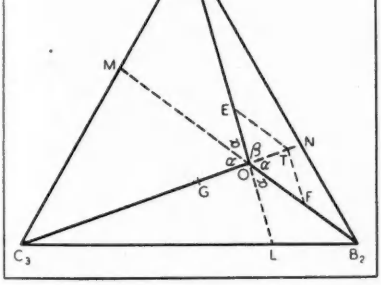


Fig. 1

represented in magnitude and phase by the lines OA_1, OB_2, and OC_3 respectively. The same lines will, of course, also represent the phase relationships of the respective line currents.

The electrical conditions prescribed by the problem are two in number. These are (a) that the vector difference of any two phase voltages should be equal to the line voltage and (b) that the vector sum of the three line currents should be zero, and it is on these that any method of solution should be based. If, however, the construction described above is accepted, then it is at least necessary to show that these conditions are involved and satisfied.

Plainly, the vector representation of Fig. 1 satisfies the first condition (a) and only the second need be considered further. Suppose that, $OE = \frac{OA_1}{R_1}$, $OF = \frac{OB_2}{R_2}$, and $OG = \frac{OC_3}{R_3}$. Then OE, OF, and OG will represent the line currents in magnitude and phase and the vector sum should therefore be zero. The condition is, $\overline{OE} + \overline{OF} + \overline{OG} = O$ . . (1) or numerically, $OE \cdot \cos\beta + OF \cdot \cos\alpha = OG$ . . . . . (2). Consider the triangles A_1 ON and B_2 ON

$$\frac{OA_1}{\sin \widehat{A_1NO}} = \frac{A_1N}{\sin\beta}, \quad \frac{OB_2}{\sin \widehat{B_2NO}} = \frac{NB_2}{\sin\alpha}$$

That is, $\frac{OA_1}{OB_2} = \frac{A_1N \cdot \sin\alpha}{NB_2 \cdot \sin\beta} = \frac{R_1 \cdot \sin\alpha}{R_2 \cdot \sin\beta}$, or $\frac{OE}{\sin\alpha} = \frac{OF}{\sin\beta}$. In a similar manner, $\frac{OF}{\sin\beta} = \frac{OG}{\sin\gamma}$, so that $\frac{OE}{\sin\alpha} = \frac{OF}{\sin\beta} = \frac{OG}{\sin\gamma} = \lambda$, say . . . . . (3).

This result expresses the fact that OE, OF, and OG can be represented as sides of a triangle, and hence that (1) is true. Otherwise, if values obtained in (3) are substituted in the condition (2) it reduces to $\sin\alpha \cdot \cos\beta + \sin\beta \cdot \cos\alpha = \sin\gamma$ or $\sin(\alpha + \beta) = \sin\gamma$. Since $\alpha + \beta = 180 - \gamma$, this relationship is obviously true and therefore (2) is satisfied, and hence condition (b).

Another Method

An alternative procedure, and one which is logically more satisfactory, is to establish the electrical conditions imposed by the problem as in (a) and (b) and hence deduce the graphical construction.

As before, let A_1 B_2, B_2 C_3, and C_3 A_1 represent the line voltages, OA_1, OB_2, and OC_3, the phase voltages, and OE, OF, and OG the corresponding line currents (see Fig. 2). The first condition (a) is satisfied immediately, and it is now necessary to express the second in geometrical form. It is not difficult to show that if any three vectors $\overline{OE}$, $\overline{OF}$ and $\overline{OG}$ have a zero resultant, the point O is the intersection of the median lines of the triangle EFG formed by joining their extremities. For if any two of the vectors $\overline{OE}$ and $\overline{OF}$ are resolved, the two

components $\overline{OS}$ must be together equal and opposite to $\overline{OG}$, whilst $\overline{SE}$ and $\overline{SF}$ must be equal and opposite to one another for zero resultant. That is, OG = 2.OS, and ES = SF, and O is, therefore, the median point. Thus, C_3O bisects EF, A_1O bisects FG, and B_2O bisects GE.

Now, $OA_1 = R_1 . OE$, and if $OB_1 = R_1 . OF$, the line A_1B_1 will be parallel to EF. Similarly, if $OA_2 = R_2 . OE$, the line A_2B_2 will be parallel to EF and both A_2B_2 and A_1B_1 are bisected by C_3O at P and Q respectively. Also, since the triangles A_1NQ and B_2NP are similar, $\frac{A_1N}{NB_2} = \frac{A_1Q}{PB_2} = \frac{A_1Q}{A_2P} = \frac{A_1O}{A_2O} = \frac{R_1 . OE}{R_2 . OE} = \frac{R_1}{R_2}$ and so on for the other sides B_2C_3 and C_3A_1.

Thus the result on which the construction depends is obtained as a geometrical development of a figure which represents the electrical problem in geometrical form.

Nowhere is it essential to the arguments to assume that $A_1B_2C_3$ is an equilateral triangle, so that the construction would be equally valid for an unbalanced supply.

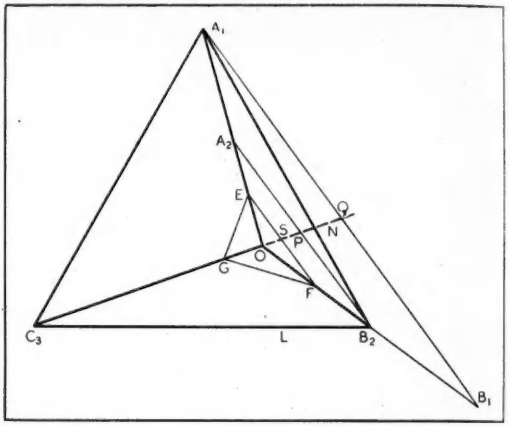
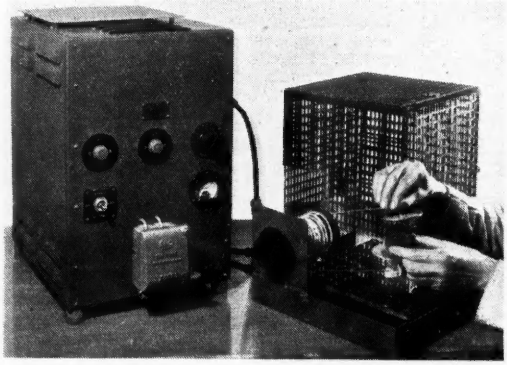


Fig. 2

Radio-frequency Heater

THE compact radio-frequency heater, known as the "Redifon RH.2" model, is now available from Rediffusion, Ltd., Broomhill Road, Wandsworth, London, S.W.18.

The valve generator measures only 20 by 18 by 13 inches, weighs 112 lb., and delivers over 250 W output at a mean frequency of about 50 Mc/s, which suffices to plasticise up to 3 oz. of moulding powder preforms per minute, or to set 100 sq. in. of urea glue line in five minutes.



Radio-frequency processing heater for non-conducting materials

Other purposes for which it has been employed include welding p.v.c., vulcanising rubber, drying latex, softening "Perspex" and other thermo-plastic substances, treating asbestos compounds and heating small steel articles.

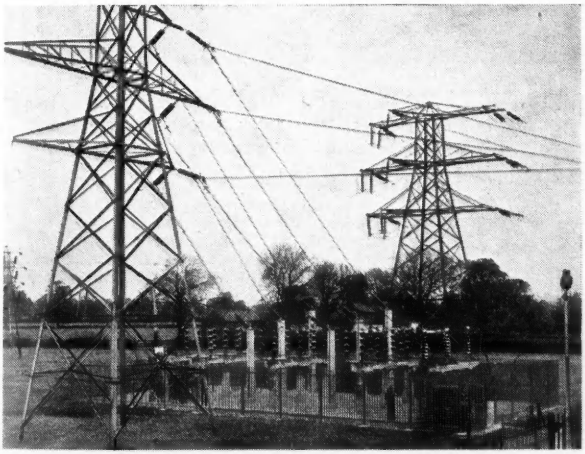
The output is taken from a concentric plug-socket through not more than 6 ft. of screened concentric cable to a variable inductance transformer, which enables almost any load to be correctly matched. The transformer is mounted in a screened box, or larger metal-mesh cage with an interlocking door, capable of accommodating specimens or holders up to some 8 in. cube. The optimum setting of the matching inductance is indicated by the anode current meter on the generator panel, there being a two-pin socket for remote meter indication when the "work" in hand is not adjacent to the generator.

Apart from the ironclad main switch with enclosed fuses there is a three-way high-voltage switch with "off," "quarter" and "full" positions in conjunction with variable adjustment of intermediate settings. There are green and red pilot lamps for the valve filament and anode circuits and a three-pin socket is provided in the high-voltage transformer primary circuit for connection to distant control or heating chamber interlock. There are radio-frequency filters in the AC mains input circuit, taking about 650 W at 180 to 250 V and 50 cycles.

Compression Cable

Experimental 132-kV Installation at York

LONG-TERM testing under service conditions for an anticipated period of five years of a new type of gas-compression cable commenced with its power loading on April 19th, 1945. The experimental three-phase circuit consists of three single-core 0·40-sq. in. cables laid in inverted pyramid formation direct in the ground round a field and connected between two pylons in series with one of the more important overhead national grid lines, which has a maximum rating of 90 MVA at 132 kV, selected because the heavy load it normally transmits fluctuates rapidly. Mid-way along the route length of 500 yards (a total of 1,500 yards of cable) is one joint-bay containing three single core joints.



General view of compression cable site at Osbaldwick, showing incoming 132-kV line towers

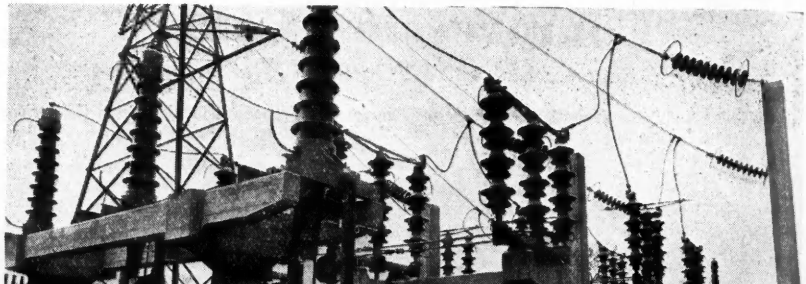
The Central Electricity Board has afforded site facilities at Osbaldwick, a few miles outside the City of York, for enclosing the reinforced concrete supports of the six sealing-bell terminations of the cables and, between them, the three 132-kV, three-phase, rotating-post B.T.H. isolators for switching the cables in and out of circuit, provided by the Enfield Cable Works, Ltd., which manufactured the cables and carried out the experimental installation in a way that should minimise interference with the normal operation of the associated overhead grid line.

The construction of the cable and arrangement of terminal "breather" accessories have already been fully described (*Electrical Review*, October 20th, 1944), but it needs to be reiterated that the compression is applied externally, not within the dielectric. The core is insulated with impregnated paper in the accepted "straight" manner, but two lead sheaths are provided, both appropriately reinforced. Between the oval inner and circular outer sheaths are "new moon" cavities (on the minor axis) filled with inert nitrogen gas, the function of which is constantly to exert a pressure of 200 lb. per sq. in. on the inner sheath. Such compression enables expansion and contraction of the dielectric during temperature fluctuation caused by varying load to be evenly accommodated, pressure adjustment being effected by metallic bellows compensators attached to the porcelain sealing bells on cable terminal posts.

Thus the inner pure lead sheath acts essentially as an impermeable diaphragm 0·08 in. thick, which is less than that of an ordinary paper-insulated cable, the outer lead sheath being 0·12 in. thick. The overall diameter of the cable is about 3 in. and its rating is 394 A, which is equivalent to 90 MVA three-phase.

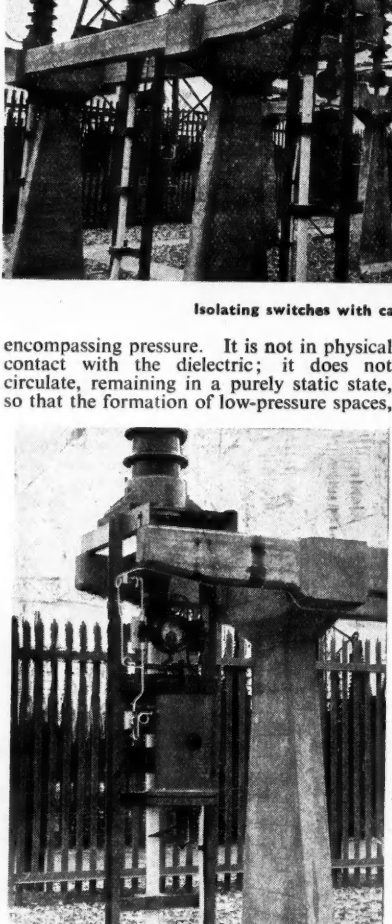
After erection on site all appropriate fittings and the completed installation were subjected to gas pressure tests of 300 and 285 lb. per sq. in. respectively for 24 hours. The average resistance of the "conductive" glaze on the "stabilised" porcelain insulators forming the cable terminals was 160 megohms at 15 deg. C. measured with a 1,000-V "Megger" tester and a routine test at twice line voltage (DC 264 kV) applied separately to each single-core cable and its accessories, between the conductor and the earth screen, for 15 minutes before the line was put into commission showed the average leakage current for each single-core cable and its two terminal insulators to be 5 mA at 15 deg. C.

It will be appreciated that the gas is utilised solely for mechanically maintaining an



Isolating switches with cable sealing bells at each end

encompassing pressure. It is not in physical contact with the dielectric; it does not circulate, remaining in a purely static state, so that the formation of low-pressure spaces, or voids, is minimised. Typical ionisation graphs are among the best we have seen.



Gas pressure compensation on cable sealing bell support

Investigation of the principles involved in the construction of compression cables commenced before 1927. Experimental 66-kV and 132-kV cables laid in the grounds of the makers' Brimsdown works from 1928 for long-time stability tests in some cases covered more than 100 heating cycles with loads producing conductor temperatures up to 90 deg. C.

Not one of the number of 66-kV cables commercially laid by the Enfield Co., which have been in regular service for several years, has so far failed in operation.

Visit of Indian Industrialists

NINE Indian industrialists are now visiting this country to discuss with British industrialists how far the United Kingdom can supply capital equipment and otherwise assist them in their plans for post-war industrial expansion in India. They are accompanied by a number of technical advisers and are expected to remain here about two months before going on to the United States. At the invitation of H.M. Government, the Association of British Chambers of Commerce and the Federation of British Industries are jointly responsible for facilitating any arrangements or contacts suggested by the Indian visitors during their stay in this country. The two organisations, on behalf of British industry and commerce, cordially welcome the opportunity this visit affords of strengthening contacts between Indian and British industrialists and will render the fullest possible assistance in arranging such business meetings as the visitors may wish.

COMMERCE and INDUSTRY

Government and Severn Scheme. Aluminium Development.

Severn Barrage

IN the House of Commons on May 18th, Sir Stanley Reed raised the question of the Severn Barrage scheme. He urged the Ministry of Fuel and Power to press forward with the examination of expert reports which had been made available.

Mr. Tom Smith, Joint Parliamentary Secretary, Ministry of Fuel and Power, replied that the Minister had not yet completed his consideration of the report of the panel of experts on the barrage scheme submitted to him last October, but the report suggested that as an engineering project it appeared clear that the barrage was feasible. It would involve an expenditure estimated by the experts of about £47,000,000—a considerable expenditure on one project during the next few years. The main economic justification for constructing the barrage would be the saving of a million tons of coal. The experts came to the conclusion that with coal at a price of not less than 49s. 1d. per ton the barrage would be economically justified for the first fifteen years of its operation. Though the price of coal to electricity undertakings had risen substantially it had not reached 49s. 1d. per ton, and it was hoped that now they could look forward to a decrease in price. The Severn Barrage proposition had not been shelved. It had been considered very thoroughly and the Minister had consulted all those who could be helpful but at the moment no decision had been taken by the Government. The Government was very much alive to the general question of harnessing water power.

Action Against Battery Makers

A "world wide conspiracy" in the distribution of electric storage batteries was alleged in an anti-trust civil action suit filed against the Electric Storage Battery Co. and the Willard Storage Battery Co. in the Federal Court at New York. The main charge was concerned with a high-grade battery the life of which was said to be ten or seven years greater than that of any other American battery. The Government contended that this battery was kept from the American market and caused substantial difference in the operation of American war equipment.—*Reuter.*

Aurora Lamps

In his speech at the company's annual meeting, Mr. G. Leslie Wates, chairman of Johnson & Phillips, Ltd., mentioned that the company had acquired the whole of the issued capital of Aurora Lamps, Ltd., Old Kilpatrick, Glasgow. The purchase includes seven acres of land and not only will J. & P. continue the lamp factory but they will also use the land for their own purposes. The management of the Aurora concern is to remain in the hands of Mr. J. B. McGillivray (chairman), Mr. J. H. Cuthbertson, B.Sc. (managing director) and Mr. J. B. Jackson, who were the promoters of the company in 1932.

During the raids on Clydeside in March, 1941, the factory was destroyed, but in six months the company was able to record 75 per cent. of full production and by the end of the year production reached its maximum. The works was the "nucleus" factory for the north and the company has produced all the general-service lamps required by the Forces, the G.P.O. and Ordnance factories, as well as continuing to serve its normal customers.

Boys in the Contracting Industry

The National Federated Electrical Association has now fixed the rate of pay for boys employed by its members in the electrical contracting industry. Boys employed for later registration under Category II are to be paid 15 per cent. of the journeyman's basic rate at the age of 14 and 17½ per cent. at the age of 15. Those employed for subsequent recognition under Category IV are to receive 17½ per cent. of the journeyman's basic rate at 14 and 20 per cent. at 15. To these payments there will be added 2d. per hour cost-of-living (war) adjustment.

An Active Met.-Vick. Bomber

Last autumn the Metropolitan-Vickers-built Lancaster "Aries" flew round the world while on a navigational mission to the Pacific, and toured the United States, Canada and South Africa. Back in this country some members of the crew visited the Works just before the naming of the 1,000th bomber produced in the Metropolitan-Vickers factory at Trafford Park last year. Now "Aries" has made another expedition to gather navigational data, this time over the North Pole. Wing Commander D. C. McKinley, D.F.C., A.F.C., a pioneer on the Atlantic service, is captain of the aircraft.

It was reported this week that the "Aries" left Iceland on Friday last and landed at Goose Bay on the North-East Canadian coast. On Saturday she reached the North Magnetic Pole and proceeded to Dorval, Montreal. She was expected to arrive back at her base towards the end of this week.

E.D.A. Exhibition at Manchester

The North West Area Committee of E.D.A. is organising an exhibition "Electricity Looks Forward," in the premises of Kendal Milne, Ltd., Deansgate, Manchester. The exhibition is to be opened at 2.30 p.m. on Tuesday next, May 29th, by Lord Brabazon, President of E.D.A., who will be accompanied by Lady Brabazon. The exhibition will run until 19th June.

"Look To Your Lights"

This is the title of a well-produced 12-page booklet just issued by the British Electrical Development Association which, as will be guessed, deals with the restoration of public lighting. It is suggested that lighting authorities should not merely be content with a reversion to their pre-war systems unless these were of a high order; the opportunity arises for the planning of improved lighting—electric lighting, of course. Examples are illustrated of better-

ment achieved by properly-planned electric lighting and stress is laid on accident prevention. Other illustrations show the progressive reduction in the cost of electric street lighting since 1926–27; the much-increased consumption of electricity for this purpose; and examples of street lighting standards. Reference is made to the recommendations of the Ministry of Transport Committee on Street Lighting and the back cover shows an example of floodlighting. In this last connection we may say that the pictures of the Victory floodlighting of London buildings in last week's issue were provided by E.D.A.

Plastics Control

The Minister of Supply has made the Control of Plastics (No. 3) (Revocation) Order, 1945 (S.R. & O. 1945 No. 539), revoking the Control of Plastics (No. 1) Order, 1940, and the Control of Plastics (No. 2) Order, 1941. Licences are no longer necessary for the acquisition, disposal, treatment, use and consumption of plastics in the form of moulding powder, in the production of which formaldehyde, phenol, cresol, urea, thiourea and cellulose acetate are involved, or synthetic resins in which formaldehyde, cresol, phenol, urea or thiourea has been used. Use of cellulose acetate moulding powders, however, must still be restricted and under arrangements with the producers releases for the time being will be on substantially the same basis as hitherto.

For the present there will be no change in the existing method of voluntary control of other types of plastics or of plasticisers.

Paper Salvage

The mobile exhibition " Your Paper Goes to War," designed and presented by the Waste Paper Recovery Association and housed in a specially-constructed trailer, has been making an extended tour of industrial areas. It has now visited over 100 factories and nearly 100,000 people have seen it, both in factories and during afternoon public showings in various towns.

The exhibition has now been entirely revised, to stress the fact that, even with victory in Europe achieved, paper salvage must continue, both for the successful prosecution of the war against Japan, and in order to meet home needs. Even when unlimited shipping space is once more available, supplies of paper-making materials will be scarce all over the world, and the deficiency must still be made up by paper salvaged at home.

Queen Mary recently spent an hour inspecting the exhibition at Badminton, the country house of the Duke and Duchess of Beaufort, where Her Majesty lived during the war.

The A.O.E.C.

The Association of Officers and Staff members of Electricity (Power and Supply) Companies of Great Britain held its annual general meeting in London on May 17th. The chair was taken by the president, Brig.-Gen. R. F. Legge, C.B.E., D.S.O., who submitted the report of the Executive Committee and the accounts for 1944.

Brig.-Gen. Legge was unamimously re-elected president for the ensuing year, and all the vice-presidents were re-elected. Three retiring members of the Committee were re-elected and three new members were elected: Messrs. W. C. Gould (Southern Areas Corporation), W. E. Budding (Edmundsons Corporation, Ltd.) and H. J. Tyler (London Electric Supply Corporation) to fill vacancies caused by the retirement of Messrs. E. M. Kindersley and T. J. Smith. The hon. treasurer (Mr. F. Judge) and the secretary (Mr. E. J. Gibbons) were also re-elected.

In his address Brig.-Gen. Legge said that last year he explained that the existing provisions for compensation did not afford protection to employees of holding companies which controlled authorised undertakings but whose work was nevertheless in or about an authorised undertaking. The Executive Committee had been in communication with the Ministry of Fuel and Power generally on the subject and had secured an assurance that the points raised by the Association would receive consideration.

Purchasing Officers' Association

Members of the Purchasing Officers' Association (London Branch) and visitors, numbering in all nearly 200, gathered in the private theatre of the British Gaumont Film Corporation at Wardour Street on May 14th, to see Guest, Keen & Nettlefold's film " From Ore to the Finished Product." Mr. R. E. Wilkins compèred the film after the introduction by Mr. Clyde Parson. Sir Samuel R. Beale, K.B.E., chairman of Guest, Keen & Nettlefold, gave a short address in the course of which he stressed the importance of having a representative body of professional buyers and urged the need for a comprehensive examination and educational scheme for the younger members of industry as outlined by the P.O.A.

After the film a development meeting of the P.O.A. was held, when Mr. W. H. Napper, branch chairman, presided. The president (Mr. F. L. Hart), the national chairman (Mr. P. T. Appleby) and other members of Council addressed the meeting on the growth, aims and activities of the Association.

Conditions in East Africa

To assist manufacturers with their export plans the Department of Overseas Trade is preparing a series of booklets reviewing commercial conditions in various countries. The latest of these, which deals with British East Africa, is obtainable, price 6d., from the Stationery Office or through booksellers.

Vactric Making Vacuum Cleaners Again

Vactric, Ltd., which celebrates the twenty-first anniversary of its formation this year, has commenced production in its new factory at Chapelhall, Airdrie, Lanarkshire. It is manufacturing a cylindrical vacuum cleaner, the " W.100 " model, first introduced in 1938, as the forerunner of the range of appliances which it is planned to produce at this factory. War restrictions have made it necessary to forgo the storage cabinet, de-mothing attachment and clip-on nozzle brush, but the cleaners will be more than welcome in many homes which have been cleanerless during war years. Hitherto, the company supplied both the wholesaler and the retailer, but in future it will supply direct to the retailer only. To achieve this object the country has been divided into sales areas, each

with its own manager, and in due course it is planned to open premises centrally situated in each area, with showroom, warehouse and service facilities. Exports also play a prominent part in the Vactric programme, and preliminary inquiries indicate very much increased markets for all types of appliances, as soon as restrictions are relaxed.

Aluminium Development Association

The president, the Hon. Geoffrey Cunliffe, and the Council of the newly formed Aluminium Development Association gave an inaugural luncheon at Claridge's on May 10th. In proposing the health of the guests, who included Sir Stafford Cripps, Minister of Aircraft Production, and Mr. Hugh Dalton, President of the Board of Trade, the president said that the new Association intended to carry out propaganda, but that this would be directed not simply to the sale of aluminium, which should be used only where it ought to be used. The three main objects of the new Association were to develop by practical means and not merely by old-fashioned sales talk, to encourage research, and to use propaganda and advertising in what it was hoped would be an intelligent manner.

An exhibition "Aluminium—from War to Peace" is to be held at Selfridge's Store, Oxford Street, London, the opening ceremony being performed by Sir Stafford Cripps at 11.30 a.m. on May 30th. The exhibition will continue until June 30th.

Canadian Aluminium Contract

Because of man-power and fuel shortages in the United States, the Aluminium Company of Canada has been asked to increase this year's shipments of ingot aluminium by 250,000,000 lb., in addition to the 1,290,000 lb. ordered for delivery from Canada before July 1st. This action is taken despite the fact that half the United States aluminium production capacity is idle, the result of insufficient man-power and an under-estimate of the supplies necessary to prosecute the war in the Far East, and to meet civilian demands. The contract has been placed in Canada because American production will be inadequate to meet demands, due to a shortage of coal. In Canada, the electricity needed to produce aluminium is generated by the water power available at Shipshaw, Shawinigan and Beauharnois, whereas the power used in the United States is generated by coal-consuming steam plants.

U.S. Restrictions Lifted

Restrictions on the manufacture and distribution of a group of products including electric motors, generators and electric safety-switches are being lifted by the United States War Production Board.—*Reuter.*

Trade Publications

De la Rue Insulation, Ltd., Imperial House, 84, Regent Street, London, W.1.—Data booklet setting out the physical and electrical properties of "Delaron," which is paper or fabric impregnated with phenol-formaldehyde and compressed into sheets, having excellent structural and dielectric characteristics; it may be bonded to synthetic rubber to form "Delaprene." Also an illustrated machining manual containing advice on how to work this laminated plastic to fine limits and in intricate forms.

Siemens Electric Lamps and Supplies, Ltd., 38, Upper Thames Street, London, E.C.4.—Priced and illustrated leaflets briefly specifying a weatherproof cast iron street lighting fuse box for mounting on a wall or post or inside a lamp standard (Z.158) and a metal-clad service switch-fuse box with detachable cable sealing chamber (Z.159).

Applicants for copies of these publications should write on business letter-headings.

Overseas Agents' Agreement

Over 500 applications have been received by the Gauge & Tool Makers' Association, Standbrook House, Old Bond Street, W.1, for copies of its specimen agreement for the employment of overseas agents. The list includes the names of a number of electrical concerns.

Trade Announcement

The head office of E. K. Cole, Ltd., is once again at Southend-on-Sea. The return from Aston Clinton, Bucks, was made on May 18th and all invoices, credit notes, statements and correspondence concerning purchases accounts should now be sent to the Ekco Works, Southend.

Holidays

British Insulated Cables, Ltd., are closing their Prescot works from July 28th to August 6th and the Helsby works from July 30th to August 6th.

Change of Name

In view of their proposed post-war activities, North London Toolmakers, Ltd., have been re-registered as N.L.T. Industries, Ltd.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered within a month from May 16th:—

LONDEX.—No. 632,010, Class 11. Electrical installations and apparatus for heating, cooking, steam generation, refrigeration, drying, ventilating, water supply and for sanitary purposes; and parts thereof not included in other classes.—Londex, Ltd., 207, Anerley Road, London, S.E.20.

HAILRAY, HAILCRIS. Nos. 633,915-6 respectively, Class 11. Glassware for lighting; and lighting fittings. Also HAILUXO. No. 633,917, Class 11. Glassware for lighting; miners' lamps; and lighting fittings.—Hailwood & Ackroyd, Ltd., Beacon Works, Texas Street, Morley, Yorks.

DUERAM. No. 630,017, Class 17. Electrical insulating materials, and electrical insulating parts made therefrom; electrical insulators.—South Shields Products, Ltd., 14, Berkeley Street, London, W.1.

ALORITE. No. 633,199, Class 17. Electrical insulators and parts, all of porcelain.—Dorman & Smith, Ltd., Ordsal Electrical Works, Middlewood Street, Salford, 5.

INSULOID. No. 635,045, Class 17. Electrical insulating materials.—Insuloid Mfg. Co., Ltd., Ford Street Mill, Chestergate, Stockport.

NEW BOOKS

The Study of Electronics

Experimental Electronics. By Ralph H. Muller, R. L. Garman and M. E. Droz. Pp. xv + 330; illus. George Allen & Unwin, Ltd., Ruskin House, 40, Museum Street, London, W.C.1. Price 21s.

The authors of this book are professors of chemistry at New York University and, to quote their preface, their intention has been " to supply definite practical information on the characteristics and non-communication applications of electron tubes." They have written chiefly for the benefit of students of chemistry, biology and engineering and their aim is to familiarise them with electronic apparatus by stimulating them to carry out numerous experiments.

With this end in view the book takes a rather unusual form, for it consists of descriptive text and illustrative experiments in roughly equal parts. The ground covered includes multi-electrode valves as well as triodes, photo-electric cells and gas-discharge tubes, power supplies and voltmeters for both DC and AC measurements. There are also chapters on photo-cell applications, untuned amplifiers, oscillators and the cathode-ray tube.

The treatment is sometimes rather sketchy, especially towards the end of the book where the subjects tend to greater complexity. In some cases the authors would have been wiser to omit all reference to complicated devices and to utilise the space to deal more fully with the simpler equipment. Thus, photo-cells are allocated thirty-three pages, of which twenty-four cover photo-emissive types and barrier-layer cells, while the remaining nine are descriptive of electron multipliers, iconoscopes and orthicons. These last are the province of the skilled electronic engineer and could well have been omitted. The practical side of the book is rather less good than the descriptive and would be improved by some expansion. The authors talk lightly about circuits using 100-megohm resistors without any mention of such practical difficulties as the avoidance of surface leakage.

Errors are few, but not entirely absent. On page 246 it is said that the replacement of the coupling resistance of an R.C. stage by an inductance of equal reactance will leave the stage gain unaltered. The authors have forgotten that this is a case where vector addition is necessary, and in fact, the change increases the gain. Further, in discussing crystal oscillators on page 277, they say that the anode circuit of a tuned anode oscillator must be tuned to the crystal frequency for " strong oscillations." In fact, the circuit would not oscillate under this condition, for it requires an inductive load for oscillation. While a very serious error from the theoretical point of view, it is unlikely to embarrass the experimenter, for he will automatically tune the anode circuit to provide the requisite inductive load.

There is a good bibliography and the book should be of value to the student who conscientiously carries out the experiments and who has access to the necessary apparatus for doing so. It is advisable that he should already possess a good basis of fundamental electrical theory, however.—W.T.C.

An Introduction to Electronics. By R. G. Hudson. Pp. 97, figs. 72. The MacMillan Co., 60, Fifth Avenue, New York, U.S.A. Price, $3.

It has been said, with much truth, that the last war was a chemists' war while this one is a physicists'. Why this statement has been made will be apparent to anyone who cares to take up the present book under review. Here he will find elementary descriptions of radar, radio compasses, iconoscopes, photons, electron orbits, cathode-ray tubes, thermionics, frequency modulation, atomic energy, electron microscope, and cyclotron. A host of other topics is lucidly touched on, with sufficient force to maintain the interest of the reader, and introduce him to the highly specialised field of electronics.

Our knowledge of the fundamental facts connected with the electron, both as particle and wave and the translation of these into practical devices has produced many good books on the subject. These, as a rule, are for the specialist, and a popular text set out in plain language and with a wealth of illustration is indeed welcome.

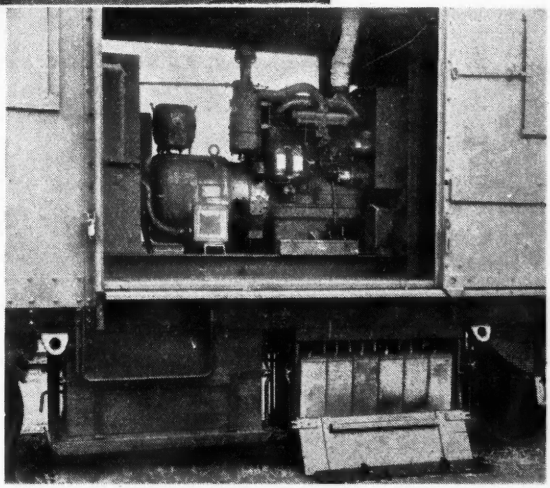
The book is divided into seven chapters, beginning with a review of our present conceptions of the constitution of matter, in which the more modern aspects are dealt with. These include the Bohr model, isotopes, cosmic rays, positrons, mesotrons, cyclotron and transmutations. The second chapter enlarges on the electrical nature of matter and gives a modern picture of the conduction process under various conditions. The remaining five chapters deal mainly with applications built on these theories, in the fields of radio communication, reproduction of sound and vision, and the very interesting work with the electron microscope.

The text is given emphasis by the very beautiful collection of thirty-five plates interspersed through it, and which illustrate the large variety of applications. These are exceptionally good, and would constitute in themselves a " liberal education " in electronics. The work is non-mathematical, and, within the limitations imposed on the author, should help to stimulate interest in an increasingly important field.—L.J.

Mobile Railway Workshops

All-Electric Vans for Emergency Repair Work

TO facilitate repairs on or near railways, particularly in connection with the restoration of transport and other services on the Continent, the War Department has had several special engineering workshop trains constructed. Each of these consists of six vans, 24 ft. long by 8 ft. wide, the first containing electrical generating plant, the second and third workshop equipment, the fourth welding plant, the fifth air compressors, and the last stores.



Six-truck mobile train workshop unit and (right) 30-kW Diesel-driven alternator, with batteries fitted underneath the truck

The generating plant comprises an American "International" model 1M-30 four-cylinder Diesel engine (petrol starting) directly driving a 30-kW, AC generator at 1,000 RPM, the exciter being mounted a top of the alternator. Normally it produces a standard (British) 400/230-V, 3-phase, 50-cycle supply, though it can be adapted to the 220/127-V, 60-cycle American system. A 100-A four-pin Reyrolle plug and socket in the end of the generator van permits the supply to be fed out to neighbouring equipment, or, alternatively, an outside mains supply can be connected up with the train.

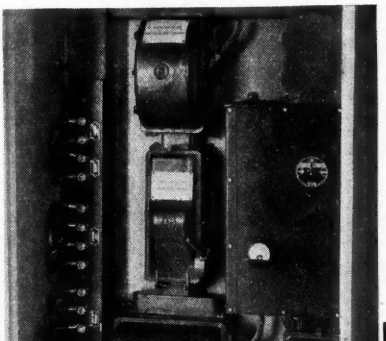
In case it is found necessary to use the generator in parallel with a second generator in another van, synchronising gear is provided on the switch panel (American G.E.) mounted on the end of the machine. This switch panel also incorporates a voltage regulator, voltmeter and under voltage device fuses, synchronising fuses, synchronising lamps and sockets, voltmeter resister (multiplier), "Silverstat" voltage regulator, and air circuit-breaker control for the whole train.

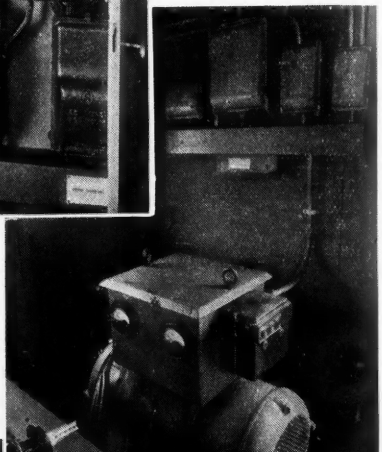
From the alternator switch panel the supply is carried to metal-clad switch- and fuse-gear (Sanders) housed in a steel cupboard at the end of the van. A change-over switch is situated close to its base, which in its "up" position provides for the supply to be taken from the alternator, the "down" position connecting with the alternative outside supply. A 30-A double-pole switch enables the lighting (25-V) circuits to be run either from the generator through a G.E.C. 2-kVA transformer, or from twelve L.M.C. "C" type batteries (supplied by Pritchett & Gold), which are suspended in two containers under the generator van and are fitted with isolating links. The batteries are charged from the generator by means of a G.E.C. trickle-charger.

The three-phase and neutral power supply

is taken through 60-A four-pin "Niphan" watertight plugs and sockets situated at the end of each van and coupled by means of flexible cable. Single-phase supplies are also provided for some of the smaller machines. The two-wire 25-V lighting supply is available for the whole train, bulkhead fittings in the roof being supplemented by Benjamin adjustable fittings over the machines and benches and by portable "gripper" type hand-lamps. All the wiring, with the exception of the flexible couplings, is v.i.r. in conduit, which in the case of the power supplies is fitted to the under-frame of the vans and for the lighting, to the roof. Spare lighting and power inter-van leads are fixed to the roof cross bars.

Equipment of workshop No. 1 comprises a Milford pedestal grinder (½-HP motor) a 15-in. sensitive vertical heavy duty Alfred Herbert pillar drill (¾-HP motor for the drill, 1/10-HP unit for the sludge pump) and an 8½-in. D. Mitchell & Co. sliding surfacing and screw-cutting machine (3-HP). Installed in the second workshop are a ⅝-in. sensitive "Ajax" vertical driller (½-HP) an Edward G. Herbert hacksaw (3-HP), a Herbert screwing machine for piping, a 20-in. Joshua stroke shaper, and a 16-ton Tangye





Electric welding plant, the main switch and fuse switch and fuse panel (top) and one of the workshop trucks (left)

hydraulic press. The local metal-clad switch-fuse units (Bill Switchgear, Ltd.) for the individual machines are grouped at the end of the vans, steel troughing (Power Centre Co.) being effectively employed here and elsewhere to avoid crossing conduits. Spare fuses are provided close to each fuse unit in screwed-down wooden boxes. In addition to a Murex electric welder (30-V, 300-A) fixed in the

welding van, there is a portable petrol-driven welding unit for outside work. The compressor unit installed in the fifth van is a Diesel-driven machine manufactured by Broom & Wade, Ltd.

The vans themselves are of American "utility" type and, brought across the Atlantic in sections, have been assembled by W. G. Bagnall, Ltd. Thorpe & Thorpe, Ltd., whose Stafford manager, Mr. G. F. Thorne we thank for assisting us in the preparation of this article, have acted as electrical contractors for this and nine similar workshop units.

Manufacturers' War Work—IV

Equipment for the Allied Forces

British National Electrics, Ltd.

As early as May, 1939, this company, in anticipation of hostilities, opened an aircraft department and commenced making tailplane units for Hurricane fighter aircraft, and continued to do so until 1944. Meanwhile other components were produced, including many hundreds of pairs of 20-ft.-long fuselage side fairings, as well as such smaller items as the rudder bar assembly, for Wellington bombers. Production was also developed of the large overload fuel tanks for the Halifax bomber, and this opened the way for hundreds of jettison tanks for American Thunderbolt fighters. Smaller components for many other types of aircraft were also handled, together with very large numbers of tropical containers.

In the sheet metal departments thousands of units for bottle rack stowage of H.A. ammunition were made for aircraft carriers, together with a constant output of lockers for mess, kit, and damage control purposes. Air-conditioning apparatus for radar equipment was also undertaken. Meanwhile the company's normal peacetime products of electric cooking and heating appliances were continued to the maximum possible, and all was performed with a high proportion of unskilled labour.

Erskine, Heap & Co., Ltd.

In the main Erskine, Heap & Co., Ltd., have been manufacturing switchgear and motor control gear for the Admiralty, Air Ministry and Ministry of Supply, as well as supplying a considerable amount of similar gear to the U.S.S.R., and many hundreds of switchboards for use in transportable power stations. For the Admiralty, apart from a large number of switchboards for various stations at home and abroad and for dockyard work, the company has manufactured shockproof watertight switchgear. Millions of parts have also been produced for Whitley and Lancaster bombers.

Erskine Heap switchboards for use in transportable power stations and (left) at a Naval Air Station

Rediffusion, Ltd.

To overcome the problem of accustoming air crews in training to the conditions they would meet in operational flying, without having to send them out over an actual

target, the Rediffusion trainer has been in use since as early as 1940 and has helped in the training of many thousands of bomber crews. The apparatus takes the form of a cubicle or, in some cases, the fuselage of a bomber, containing all the usual instruments found in an aeroplane. The compartment is connected to the instructor by wire, and it is possible to reproduce all the aural and visual effects the crew would experience.

Dynamo & Motor Repairs, Ltd.

The production of motor generator sets has been the principal war activity in the manufacturing section of Dynamo & Motor Repairs, Ltd. Typical of the thousands made in wide and interesting variety are motor alternators for anti-submarine detection and scientific and testing establishments; frequency changers; motor generators for electricity supply conversion in factories, in the field, on the quayside, at home and overseas; motor generator sets for special and vital applications; and armatures for aircraft generators. All this work has been superimposed upon much extended activity in the sphere of electrical repairs, rewinding and reconditioning, consequent upon the heavy demands from the Ministries, the Forces and public utility undertakings.

Moffats, Ltd.

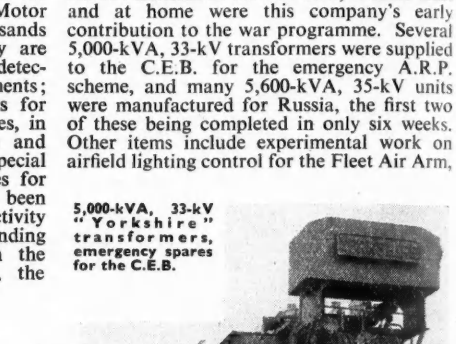
For five weeks before the invasion of France, the infra-red paint-drying plant at Moffats' factory was in operation day and night fabricating hundreds of tons of steel sheets up to 10 gauge for use in making tanks waterproof. This type of drying plant has also proved most valuable in the speeding up of production of the paint and oil drums, of which the company has manufactured approximately 250,000, and also of Bren magazine boxes and ammunition boxes, of which it has produced about 130,000. In addition the company has turned out several thousand 10-in. signalling projector switches.

Universal Boilers & Engineering Co., Ltd.

Well known before the war for its washboilers and now busily engaged with post-war plans for manufacturing the Poplar all-electric kitchen unit, a new type of washing machine and probably an automatic dish-washing machine too, the Universal Boilers & Engineering Co., Ltd., in 1938 established an associate firm, Burnley Aircaft Products, Ltd. Owing to the prominent part it has taken in aircraft manufacture and repair, this offspring has, if anything, become better known than its parent. A knock-off escape door, which has probably contributed much towards saving the lives of airmen, was developed in its works. Jettison tanks and bomb doors are also items which have figured largely in the company's production, while successive improvements in method have made for substantial man-hour economies. Much of the old Blenheim programme was executed at the company's works, as well as the production of Stirling heavy bombers. Jigs for gliders and tools for a multiplicity of war jobs have also been produced.

Yorkshire Electric Transformer Co., Ltd.

Many hundreds of transformers for R.A.F. airfields in the Far East, Middle East and at home were this company's early contribution to the war programme. Several 5,000-kVA, 33-kV transformers were supplied to the C.E.B. for the emergency A.R.P. scheme, and many 5,600-kVA, 35-kV units were manufactured for Russia, the first two of these being completed in only six weeks. Other items include experimental work on airfield lighting control for the Fleet Air Arm,



5,000-kVA, 33-kV "Yorkshire" transformers, emergency spares for the C.E.B.

large power station transformers for ordnance factories, and distribution and special transformers for Admiralty establishments in all parts of the Empire. Also under the relief and rehabilitation schemes "Yorkshire" transformers are playing their part in the restoration of power supplies in Europe.

Fabricated steel structures have formed a large part of the production, and bridging equipments have included many thousand panels for Bailey bridges, chord reinforcements for the Bailey pontoon bridges and sections of the "V" trestling railway bridge, totalling more than 50,000 separate parts. Mulberry Harbour was also contributed to in the shape of bombardon tanks for the outer breakwaters. Many parts have also been fabricated for the Sherman and other tanks.

Next Winter's Load

Precautions Recommended by the Commissioners

REPETITION of the conditions which prevailed last winter is anticipated in a letter which the Electricity Commissioners have sent to the chief engineers and managers of all authorised electricity undertakings. They say that although the extent to which the maximum electricity demand in the country generally may be affected by the conclusion of the war in Europe cannot be estimated with any certainty, some shedding of load may be unavoidable during the next two winters, especially in the event of a severe cold spell. The Minister of Fuel and Power has therefore asked the Commissioners to seek the co-operation of all electricity undertakings in minimising inconvenience and loss to consumers.

Arrangements with Industrial Concerns

A number of undertakings supplying large power consumers have been able to make satisfactory arrangements by which, on receipt of a telephone message, the industrial load in certain factories is reduced by the amount required, and supplies to domestic consumers, shops, hospitals, and those factories, etc., engaged on continuous process work, have not been affected. Engineers and managers are asked to consider, if they have not already done so, how far such a procedure is feasible in the case of their undertaking. Such an arrangement is dependent upon the willing co-operation of the principal industrial consumers, and involves the preparation of a list of these consumers with the extent of possible load reduction in each case. The list should be divided into groups so that no one consumer is asked to curtail his demand more frequently than necessary.

In the case of undertakings with no large industrial consumers, consideration should be given to the districts which, in emergency, must be disconnected (in rotation), avoiding, as far as possible, interruption of supplies to factories, etc., engaged on continuous process work, hospitals and similar establishments, especially without prior warning.

The Central Electricity Board, whenever possible, will notify undertakers before midnight when there are signs that load shedding is likely to be required during the following morning. Undertakers will then be in a position to pass on this information to those of their consumers who may be affected, so that they can take quick and effective action when a request for load shedding is issued by Central Board Control. Any undertakers receiving such a warning should immediately transmit it to any undertakers to whom they give a bulk supply.

The possibility of load having to be shed during the coming winters would be greatly reduced, if not eliminated, if arrangements could be made by industrial consumers for a more substantial transfer of load from the morning to the afternoon period, thereby reducing the peak load. In the Commissioners' circular letter of December 1st, 1944, it was shown that the difference between the morning and afternoon national load was of the order of 870,000 kW. The maximum possible transfer of load from the morning to the afternoon period is equally necessary during the summer months when it is necessary to overhaul and repair plant in order to ensure as far as possible adequate supplies during next winter. After the essential withdrawals of plant for repair and maintenance, the margin available for operation during the summer months is already dangerously low. The excess of the morning demand over the afternoon demand is now of the order of 1,190,000 kW.

The Regional Boards of the Ministries of Production and Food have been asked to co-operate and may ask for support in their discussions with large industrial consumers.

Surplus "Private" Power

Risk of load shedding may be further reduced if undertakers can make any arrangements to supplement their supply at peak periods by taking surplus power from private plants in their areas. Undertakers should also investigate the possibility of coming to an arrangement with the owner of any stand-by Diesel-engine plant in their area for its operation so as to relieve the public supply system of the whole or part of the demand normally made by the owners of the plant. The Air Ministry has indicated that some of the plant at its establishments could be used for this purpose.

Unless some such arrangements have already been made, undertakings are asked to get into touch with the owners of Diesel plant in their areas with a view to making the best possible arrangements for its operation probably at short notice during emergency peak hours.

In some cases it may not be possible or desirable to run Diesel plant in parallel with the public supply system, and special switching arrangements may have to be made.

In view of the oil supply position and of the necessity for the strictest economy in the consumption of fuel for power production, the operation of plant under the arrangements contemplated above should as far as practicable be confined to any "danger period."

ELECTRICITY SUPPLY

New West Hampshire Tariff. British Plant in New Zealand.

Aldershot.—ELECTRICITY ON NEW ESTATES.—The Works Committee has recommended that electricity be used for cooking, wash boilers and lighting on the Bellevue Road Estate. It is proposed to use electricity for lighting only on the Lower Farnham Road estate.

SERVICES.—It is recommended by the Electricity Committee that mains be laid free of charge in the roads on the temporary housing estates.

INCREASE IN CONSUMPTION.—During the year ended March 31st last the Electricity Committee purchased 35,100,900 kWh as compared with 29,299,800 kWh during the preceding year—an increase of 19·79 per cent. Increased consumption, higher maximum demand and dearer coal have increased the cost of electricity purchased from £31,719 to £38,005. This represents an increase of 0·061d. in the cost per kWh purchased.

Bedford.—LOANS.—The Electricity Committee has obtained sanction to borrow £3,028 for mains and equipment and £115,000 for the technical development of the undertaking.

Carlisle.—SUPPLY TO GRETNA.—In order to provide an electricity supply to Guaros Farm, Gretna, it is proposed to extend the high-voltage transmission cable from Black Bank substation *via* Mill Hill, Gretna Station and Sark Bank. The extension, which will include three substations, will enable the Corporation to serve certain premises now being supplied by the Dumfriesshire County Council under Fringe Orders, and it is proposed to apply for the revocation of the Orders. Application is to be made for sanction to borrow £2,730 plus any sum agreed to be paid to the Dumfriesshire County Council.

Dingwall.—STREET LIGHTING DECISION.—The Town Council at its last meeting decided by seven votes to six to adopt electricity for street lighting in place of gas. It is estimated that this will involve a rate of 7½d. in the £1.

Hastings.—ADDITIONAL SUPPLY.—The Electricity Committee is to extend substation equipment at a cost of £1,575 to provide an additional supply to Gypsum Mines, Ltd., which is to install additional electric motors at its works for driving machinery to increase the output of plaster required for building works.

LOANS.—Application is being made for sanction to borrow £5,000 for mains and services, £3,000 for meters, £3,000 for substations and £3,000 for apparatus.

Hull.—COST OF COAL.—In a report to the Electricity Committee the general manager (Mr. D. Bellamy) said that the increase of 3s. 6d. a ton in the price of coal which came into force on May 1st meant an additional £35,000 expenditure per annum to the Electricity Department. Fuel costs were now 136 per cent. higher than before the war, which represented roughly £200,000 a year to them. He pointed out that coincident with each successive increase in price which had taken place, there had been a general fall in heating values, which represented an enormous sum of money apart from the extra cost of labour and transport. There were penalties for adulteration of other commodities but no account, he added, was taken in the coal industry of the question of quality. Percentage additions should maintain some relation between price and quality. He said that a letter embodying these views framed by the Mid-East Midland Coal Supplies Committee was being sent to the Minister of Fuel and Power asking him to take such action as might be expedient. On the recommendation of Mr. Bellamy the Electricity Committee decided that copies of the terms of the letter should be sent to the local M.P.s.

Newport (Mon.).—PROPOSED PRICE REDUCTION.—In 1940 electricity charges were increased by 10 per cent. This addition has recently been halved, following a report by the borough electrical engineer, and it is now recommended that in the case of non-industrial consumers the remaining 5 per cent. addition shall be removed as from the June quarter meter readings. This is opposed by some members of the Council on the grounds that the time is not opportune for this further concession to be made.

Oswestry.—REFUND FROM COMPANY.—At a recent meeting of the Town Council it was reported that after negotiations with the North Wales Power Co. and various electricity authorities in North Wales the company had decided to refund £40,000, of which about £3,000 would be received by the Oswestry undertaking. Councillor L. D. E. Turner said that half of this would go in taxes and the remainder would be used to meet the cost of certain works out of revenue instead of raising a loan.

Stockton-on-Tees. — SUBSTATIONS. — The Town Council intends to start work without delay on new substations in West Row (£13,000), in Outram Street (£7,094), Norton High Street (£10,855) and Norton Road (£5,472). A supply of electricity is to be provided to Albany Road housing site at a cost of £8,140.

Swansea.—SUPPLY TO STEELWORKS.—The Electricity Committee has arranged terms for the provision of a supply to the Upper Forest & Worcester Steel & Tinplate Works, Ltd.

Torquay.—DISTRIBUTION WORKS.—Mains and substations are to be provided by the Electricity Committee at Newton Abbot at a cost of £16,500 and in the central area (£2,200).

Permission has been given for the Urban Electric Supply Co. to afford a supply to consumers at Dittisham, in the Corporation's supply area.

West Hampshire.—NEW BLOCK TARIFF.—The West Hampshire Electricity Co., Ltd., and the Ringwood Electric Supply Co., Ltd., have announced reductions in charges which, it s stated, represent a saving to consumers of about £20,000 a year. One of the changes, according to the *Bournemouth Daily Echo*, is the introduction of new block rates, in place of the existing two-part tariffs. After a limited number of kWh at the primary rate of 7d. (or

6d. in the boroughs of Romsey and Eastleigh and the parish of Eling) all supplies will be at the uniform rate of 1d. per kWh; there will be no meter rents.

West Hartlepool.—SUBSTATIONS.—The Town Council proposes to provide a new substation in Park Square, and external substations in Thornhill Gardens and Borrowdale Street.

Overseas

Brazil.—WATER-POWER PLANT.—According to the *Bulletin* of the Brazilian Federal Council of Foreign Trade, the capacity of the hydro-electric power plants in Brazil in operation at the end of 1943 amounted to 176,000 kW or about 14·2 per cent. of the estimated total potential water power available in the country.

Canada.—ONTARIO FARM SUPPLIES.—The Ontario Hydro-Electric Power Commission has undertaken a five-year plan of rural electrification by which an expenditure of $22,439,875, will make the Commission's services available to nearly 85 per cent. of the farmers within the areas it serves, compared with 55 per cent. at present.

SHAWINIGAN PROGRAMME.—The 1945 construction programme of the Shawinigan Water & Power Co. and its subsidiary and associated companies will involve capital expenditures approximating $7,000,000, according to a statement by Mr. James Wilson, president. The parent company has improvements under way which will require approximately $2,800,000 in connection with power plants, generating equipment, rural line extensions and substation arrangements. Similar expenditures for Quebec Power Co. are estimated at $1,680,000.

India.—DEVELOPMENT IN THE SOUTH.—Elaborate post-war plans for industrial development in the States of Southern India, involving an expenditure of over £300,000,000 were outlined by Sir William Barton, former British Resident in Baroda, Mysore and Hyderabad. He was reading a paper before the India and Burma Section of the Royal Society of Arts last week.

In Hyderabad many new factories had been started as a result of the stimulus of war, Sir William stated. An industrial city was to be set up on the banks of the Godavari River, with an electrical scheme bringing water to nearly a million acres. Steel, coal, cement, textiles, vegetable oils, rayon, calcium, carbide, fertilisers and plastics would be produced in this city, to start which £18,000,000 would be required. The State grid would make possible the electrification of every village.

In Mysore, vegetable dye-stuffs, radio sets, bicycles, tractors and plastics were to be manufactured, 10,000 houses were to be built in Bangalore, £3,000,000 was to be spent on railways, and electrification was being considered. The States would generally look to Britain for the supply of the equipment and technique they would need for the carrying out of their industrial programmes, and they would be reluctant to conclude with British India an agreement that might in any way impede British co-operation.

New Zealand.—LARGE SUBSTATION.—A note in the *New Zealand Electrical Journal* states that the Central Park substation, Wellington, now almost completed, is the second largest in the North Island and will make a radical change in the City Council's distribution system previously supplied from the Khandallah substation. Bulk power is brought at 110 kV by a new transmission line which passes over the hills to Central Park. The whole of the equipment is of British manufacture and is stated to have arrived with remarkably little delay in spite of war conditions. The main units are from the B.T.H. Co. (transformers and 11-kV switchgear), Metropolitan-Vickers (110-kV switchgear and controls), Asea Electric (110-kV control), Ferranti (metering), English Electric Co. (reactors) and Standard Telephones & Cables (supervisory control). Cables were supplied by various British manufacturers.

Spain.—INTERCONNECTION SCHEME.—In view of the shortage of power the Spanish Ministry of Industry and Commerce has recently given its approval to an important scheme of generating station interconnection to enable supply undertakings to assist one another. Three interconnecting lines are included in the scheme: a 50,000-kVA 110/130-kV line connecting the distribution system in Catalonia with that of the Iber-Duero Co.; a 10,000-kVA 60/130-kV line between the systems of the Energia e Industrias Aragonesas and Iber-Duero undertakings; and a 130/70-kV line to link up the systems of the Sociedad Hidroelectrica Espanola and the Compania Mengemor.

Sweden.—POWER PRODUCTION IN 1944.—According to recently published figures, electric power generation during 1944 reached a record figure of 12,300 million kWh compared with 11,000 million kWh in 1943. The increase was particularly noticeable during the latter half of 1944, when construction of several big power plants was completed.—*Reuter's Trade Service.*

Switzerland.—NEW GENERATING STATION.—An important new hydro-electric power plant has been put into operation at Verbois, near Geneva. The station, which is situated near the confluence of the Rivers Rodano and Arve, has been designed to accommodate four sets of vertical-shaft turbines and three-phase alternators, of which three 22,000-kW sets generating at 18,000 V have so far been installed.

TRANSPORT

Ipswich.—TROLLEY-BUSES.—The Ministry of War Transport has extended the time for the commencement of the running of trolley-buses on certain routes under the Ipswich Corporation (Trolley Vehicles) Order, 1935, until August 2nd, 1950.

Spain.—NEW ELECTRIC LOCOMOTIVE.—According to *Metalurgia y Electricidad* tests have recently been completed of the first electric locomotive built at the Devis Talleres in Valencia for use on the electrified railway between Madrid, Avila and Segovia. It has an overall length of 55¾ ft. and weighs 99 metric tons, of which the electrical equipment, which has been mainly obtained from Switzerland, is responsible for 35 tons. The engine is equipped with six traction motors, capable of developing 3,000 HP at a one-hour rating of 1,350 V, and 2,400 HP continuously.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

Southern Areas Electric Corporation, Ltd., reports a total revenue of £64,625 against £52,188; the net profit rose from £21,620 to £27,667. General reserve receives £15,000 (against £4,800) and the dividend is maintained at 5 per cent. The report states that offers have been accepted from the County of London Electric Supply Co. for the whole of the issued shares of the Brentwood District Electric Co., in exchange for an equivalent number of fully paid £1 shares in the County Co.; and for the purchase in cash by the S.W.S. Power Co. of shares in the Leominster Electric Supply Co.

At the annual meeting on May 16th the chairman (Viscount Elibank), referred to these transactions and also said that a cable manufacturing interest had been sold. The company's manufacturing interests had been increased by a further investment in Mawdsley's, Ltd.; and the acquisition of a controlling interest in P.A.M., Ltd., precision instrument makers, and in Gillott Electro-Steam Cookers, Ltd., which contemplated marketing a new type of cooking equipment. Between 1939 and 1944 sales by the company's undertakings rose from 8,764,824 to 16,884,717 kWh; although the average cost per kWh bought had risen from 0·652d. to 0·836d., the average selling price had been reduced from 1·946d. to 1·91d.

The Rheostatic Co., Ltd.—Mr. L. Satchwell (chairman), addressing the annual meeting on May 16th said that during the war the manufacture of their temperature controlling instruments and resistances had been increased considerably. The company had taken various dispersal premises and had produced a very strong flow of electro-technical articles for the Navy and R.A.F. The company's leadership in temperature control and fuel economy was well recognised. Greater space was needed and additional premises had been purchased at Frimley, Surrey, and were now being adapted. It was hoped that they would be permitted to employ disabled persons, for whom their work was specially suited. The manager of their French company, La Thermostatique, S.A., had reported that the plant and assets were intact and the organisation had been re-established.

The Metropolitan Electric Cable & Construction Co., Ltd., reports that the net profit for 1944, before providing for taxation, deferred repairs and ordinary dividends, was £56,881. It is proposed to pay a total dividend of 15 per cent., against 7½ per cent.

The River Plate Electricity & Other Securities Corporation, Ltd., is to pay a final dividend of 6 per cent. (5 per cent.) making 8 per cent. (7 per cent.). Net profits for the year ended April 15th amounted to £32,078 (£31,539). A sum of £1,581 (£2,973) is transferred to reserve and £18,663 (£15,545) is carried forward.

The West Devon Electric Supply Co., Ltd., reports a gross revenue for 1944 of £104,337 (against £90,499) with a balance after meeting expenses and depreciation of £34,818 (£31,148). To this are added interest, £267 (£480) and dividends from subsidiaries £2,500 (nil). Besides £3,803 (£1,985) income tax, £5,000 (nil) is allocated to taxation reserve and general reserve receives £3,000 (same). The ordinary dividend is maintained at 5 per cent. and £5,182 (£5,170) is carried forward.

The Sturtevant Engineering Co., Ltd., records a net profit for 1944 amounting to £25,074 (£25,553). The building reserve takes £10,000 (£6,000), but no provision is made for contingencies. A final dividend of 2½ per cent. and a bonus of 3¾ per cent. make 11¼ per cent. tax free (10 per cent. tax free) and £10,511 (£9,137) is carried forward.

The Hoffman Manufacturing Co., Ltd., is not paying a final dividend this year. An interim of 7½ per cent. tax free has been paid. Last year the total distribution was 10 per cent. free of tax.

Edmundsons Electricity Corporation, Ltd., are again paying a final ordinary dividend of 3½ per cent., making 6 per cent. for the year.

John I. Thornycroft & Co., Ltd., have declared an interim ordinary dividend of 5 per cent., as last year.

New Companies

Wholesale Electrical Components, Ltd.—Public company. Registered May 11th. Capital, £10,000. Objects: To carry on the business of wholesale dealers in electrical plant, machinery and apparatus, including radio transmission and television equipment, etc. Directors: Sir Harold Moore, C.A., The Saltings, Old Bosham, Sussex, J. R. Stevens, C.A., 14, Oaklands Road, Bromley, Kent, A. J. Shrowsbury, 1, Edgwarebury Court, Edgware, Middlesex, and M. H. Selby, Hornbeam, Pearks Lane, Great Missenden. Registered office: 30, Cornhill, E.C.3.

Duplex Electric Tools, Ltd.—Private company. Registered May 7th. Capital, £2,000. Objects: To acquire the business of manufacturers of duplex electric drills and certain portable electric tools carried on by Grimston Electric Tools, Ltd., at Progress Way, Purley Way, Croydon. Directors: T. W. Wilks and Mrs. M. D. Wilks, both of Southacre, Ivy Mill Close, Godstone, Surrey. Registered office: Southacre, Ivy Mill Close, Godstone, Surrey.

Electric & General Equipment, Ltd.—Private company. Registered in Dublin May 4th. Capital, £100. Objects: To carry on the business of importers and exporters of electrical machinery, plant, apparatus and accessories etc. Subscribers: G. O. Lyons, 26, Belgrave Square South, Rathmines, Dublin, and J. M. Dowling, 24, Innisfallen Parade, Dublin.

R. N. Reed Ignition Service, Ltd.—Private company. Registered May 12th. Capital, £2,000. Objects: To carry on the business of sellers of all products manufactured by the Chloride Electrical Storage Co., Ltd., and that of repairers of automobile and radio batteries

and overhaulers and repairers of all types of automobile equipment, etc. Permanent directors: R. N. Reed, Mrs. Sarah S. M. Reed and Miss Dorothy A. Reed, all of 201, New King's Road, Parson's Green, S.W.6. Registered office: 201, New King's Road, Parson's Green, S.W.6.

W. J. Parry & Co. (Nottingham), Ltd.—Private company. Registered May 5th. Capital, £10,000. Objects: To acquire the business of electrical and general engineers formerly carried on by W. J. Parry and H. C. Martin as W. J. Parry & Co. at Beeston, Notts. First directors: W. J. Parry (permanent managing director and chairman), 47, Humber Road, Beeston, and H. C. Martin, 16, Endsleigh Gardens, Beeston. Secretary: H. C. Martin. Registered office: Lombard House, Lower Parliament Street, Nottingham.

J. Maizner, Ltd.—Private company. Registered May 5th. Capital, £2,000. Objects: To acquire the business of a radio and gramophone dealer formerly carried on by Jack Maizner, as "Peckham Gram & Radio Stores," at 141, High Street, Peckham, and to carry on the business of manufacturers of, and dealers in, radio, television and electrical equipment, etc. Directors: J. Maizner, 49, Manor Avenue, Brockley, S.E.4, and J. Zeff, Laracon, Penn Road, Hazlemere, Bucks. Registered office: 108, Rye Lane, Peckham, S.E.15.

Artshades, Ltd.—Private company. Registered May 7th. Capital, £500. Objects: To carry on the business of electrical equipment specialists, wholesale and retail dealers in lamp shades in metal and fabric, etc. Subscribers: M. Wantling, 15, Chiltern Crescent, Earley, Reading, and M. G. Jackson, 8, Barclose Avenue, Caversham, Reading. Secretary: Patricia M. Wantling. Registered office: 46, Market Place, Reading.

Companies to be Struck off the Register

The following companies are to be struck off the Register unless cause to the contrary is shown within three months from May 18th:—The Ismay Refrigerating Co., Ltd., Zeros (Sales), Ltd., and the Kensal Radio Manufacturing Co., Ltd.

Companies' Returns

Statements of Capital

Jeary Electrical Co., Ltd.—Capital, £15,000 in 12,000 cumulative participating preference and 3,000 ordinary shares of £1. Return dated November 26th, 1943 (filed October 21st, 1944). 7,000 preference and 3,000 ordinary shares taken up. £7,000 paid on the preference. £3,000 considered as paid on the ordinary shares. Mortgages and charges: Nil.

Magna Wire & Cable Co., Ltd.—Capital, £11,000 in 10,000 preference shares of £1 and 20,000 ordinary shares of 1s. Return dated October 18th, 1944. 2,027 preference and 11,600 ordinary shares taken up. £2,027 paid on 2,027 preference and £580 considered as paid on 11,600 ordinary shares. Mortgages and charges: Nil.

Keighley Electrical Engineering Co., Ltd. (renamed **Keighley Lifts, Ltd.**, on January 27th, 1945).—Capital, £10,000 in £1 shares (7,000 ordinary and 3,000 preference). Return dated November 15th, 1944. 4,281 ordinary and 2,671 preference shares taken up. £4,940 paid. £2,012 considered as paid. Mortgages and charges: £7,000.

Conduit Fittings, Ltd.—Capital, £500 in £1 shares. Return dated March 4th, 1944 (filed November 27th, 1944). All shares taken up. £500 paid. Mortgages and charges: Nil.

Eltron, Ltd.—Capital, £1,000 in 750 "A" and 250 "B" shares of £1. Return dated October 16th, 1944. All shares taken up. £1,000 paid. Mortgages and charges: Nil.

Henderson & Priestley, Ltd.—Capital, £5,000 in £1 shares. Return dated September 11th, 1944. 2,836 shares taken up. £2,836 paid. Mortgages and charges: Nil.

Wilfrid Francis & Co., Ltd.—Capital, £1,000 in £1 shares. Return dated August 30th (filed October 18th), 1944. All shares taken up. £1,000 paid. Mortgages and charges: Nil.

Actadis, Ltd.—Capital, £10,000 in £1 shares. Return dated September 13th, 1944. All shares taken up. £10,000 paid. Mortgages and charges: Nil.

Nivalight (1928), Ltd.—Capital, £5,000 in £1 shares. Return dated November 30th, 1944. All shares taken up. £5,000 paid. Mortgages and charges : £5,000.

All-Power Transformers, Ltd.—Capital, £100 in £1 shares. Return dated September 28th, 1944. All shares taken up. £100 paid. Mortgages and charges: Nil.

Cable Covers, Ltd.—Capital, £10,000 in £1 shares. Return dated October 12th, 1944. 1,002 shares taken up. £1,002 paid. Mortgages and charges: Nil.

C. A. Sothers, Ltd.—Capital, £2,500 in £1 shares. Return dated June 19th, 1944 (filed January 6th, 1945). 1,688 shares taken up. £1,145 paid. £543 considered as paid. Mortgages and charges: £1,200 issued (£1,000 paid).

Mansbridge Condenser Co., Ltd.—Capital, £25,000 in £1 shares. Return dated October 9th. All shares taken up. £10,000 paid. £15,000 considered as paid. Mortgages and charges: Nil.

Receivers Released

Standard Switchgear, Ltd.—C. F. Bland, of 11, Sir Isaac's Walk, Colchester, ceased to act as receiver and/or manager on April 30th, 1945.

"T.X." Products Co., Ltd.—F. W. Inns, 80/86, Regent Street, W.1, ceased to act as receiver and/or manager on April 28th.

Bankruptcies

D. A. M. Trew, electrical dealer, lately carrying on business as "Trew Electrical Service" at 50, Primrose Hill, Coventry.—Discharge granted April 16th subject to bankrupt's consenting to judgment for £75 being entered against him by the Official Receiver.

T. P. Wood and **T. George**, trading in partnership as electrical contractors under the style of "T. P. Wood" at 28, Queen Street, Ipswich. (Separate application of T. P. Wood.)—Discharge, suspended for six weeks, to take effect from May 30th.

STOCKS AND SHARES

TUESDAY EVENING.

WHITSUN and the warmer weather introduced a holiday note into Stock Exchange markets, where business has been spasmodic and the tone uncertain. Post-war possibilities have lost part of their previous attraction. The disposition of investment, and of speculation, too, is to wait upon the course of events. There is a disinclination on the part of the public to take any active interest, although here and there—notably in the radio and the gold-mining markets—animation has been manifest.

Home Electricity

The home electricity supply group holds its prices with firmness. The rise which has taken place so steadily during the past five months would seem, however, to have reached its apex for the time being; there is now rather less demand for the ordinary shares in this group. Holders are not parting from their interests, and expectation looks for the previously-paid dividends to be continued in spite of the changed conditions that will come about as a result of the end of the war. Shares in the London companies are not, however, at their recent best. London Associated eased off to 27s. 6d., Northmet Power to 42s. and County of London to 44s. 6d. Llanelly lost 6d., at 29s. 6d.; Midland Counties at 43s. 9d. and Northamptons at 51s. are similarly lower.

Radio Activity

The liveliest section of the industrial market is that for radio shares. Here, A. C. Cossor ordinary were the subject of an insistent demand which raised the price from 33s. 6d. to 37s. before it reacted to 36s. 6d. Accompanying the support was a rumour that the company may issue new shares—presumably on terms that will give a bonus to the proprietors—in connection with its American associations. Hard upon the heels of this advance, E.M.I. followed with a florin gain, to 36s. 9d. Pye deferred remained at 32s. 6d., Philco at 15s. and E. K. Cole at 41s. 3d.

Mixed Movements in Prices

Hopkinsons are 2s. 6d. higher at 82s. 6d. on the increase of 2½ per cent. to 20 per cent. in the dividend and Callender's are similarly better at 6 $\frac{5}{16}$. The latter have left British Insulated behind, at 6 $\frac{3}{16}$. Henley's touched 30s. before going back to 28s. 9d., equal to 5¾ for a £1 share. Automatic Telephones gave way to 67s. 6d., a fall of 2s. 6d. Metal Industries " B " at 49s. are 1s. 6d. lower, as are H.T.A. at 30s. 6d. Enfield Cables, 67s. 6d., and Ericsson Telephones, 55s., have lost small amounts. Tube Investments at 5$\frac{3}{8}$ are half-a-crown lower. Ransome & Marles gave way to 88s. 9d.

Cable & Wireless ordinary is 1½ down at 92½, the preference remaining at 113½. No official statement has been made as to the establishment of a Communication Board being contemplated. The report of such a possibility sent up Cable ordinary to nearly 100 at the end of last month. Canadian Marconi at 13s. 9d. have gained a few pence. International Telephone & Telegraph at 35 went back a point. Anglo-Portuguese Telephones reverted to 28s. At 12s. Telephone Rentals are 6d. down.

I.C. Gas

Imperial Continental Gas Association, a large holder of Edmundsons Electricity Corporation ordinary shares, gave its proprietors a pleasant surprise last Thursday by declaring dividends making, in all, 10 per cent. on the ordinary stock. This is the first time that anything has been distributed for five years, and the price of the stock responded with a rise of 15 points, to 134, comparing with a lowest of 29 touched at the time of the French withdrawal in 1940. Besides the Edmundson's interest, I.C. Gas has extensive holdings in various Continental gas and electricity companies. The sudden rise brought in sellers and the price reacted a couple of points.

Ever Ready

Ever Ready shares have come back to 43s. on the issue of a report showing that the trading profit for the year to March 31st last is £72,600 lower than that of the preceding twelvemonth. The chairman's statement declares that the fall in the profit is due to the reduction of the capital structure for E.P.T. purposes, owing to the writing-down of property and plant. The net profit permitted under E.P.T., says the chairman's statement, is £588,900, which is £32,900 lower on the year. As already announced, the company is maintaining its usual dividend of 40 per cent. At 43s., the yield is £4 13s. per cent. on the money. The balance-sheet is strong and the shares are to be regarded as a sound industrial investment.

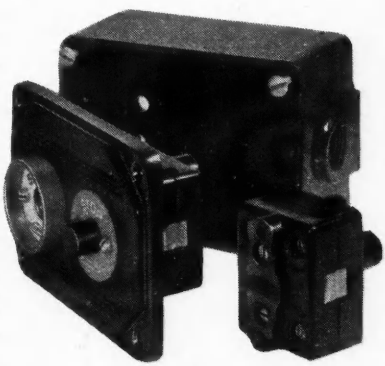
Southern Areas

Southern Areas Electric Corporation held its meeting last week, and the chairman stated that a cable manufacturing interest had been sold and shares in the Brentwood District Electric Company exchanged for a similar number of shares in the County of London Electric Supply Company. This was, of course, announced last year. The Corporation has paid a dividend on its ordinary shares of 5 per cent. for eight consecutive years, and at the present price of 24s. the yield on the money is £4 3s. 4d. per cent.

Low-Voltage Switches

Moulded Block-type for Push-button Actuation

MODERN control gear for small current circuits is tending to be designed not only with regard for electrical efficiency and mechanical adequacy, but also to be pleasing in appearance and not too expensive in first cost. An example is the push-button switch of the block type made by Brookhirst Switchgear, Ltd., Northgate Works, Chester. Its split housing and push-bar are moulded of "Duraplas," the two halves being identical except for the hole in one portion through which the push-bar projects; this "commoning" is of economic value when tooling up for moulding. Within the housing rest the "fixed" contacts, which are not attached in any way. They are easy fits in registration recesses provided for that purpose, which means that small wiring connections can be made with ease without the need to manœuvre a screw driver into inaccessible places. All four fixed contact assemblies are interchangeable. The moving contact assembly is free to rotate in a plane normal to the major axis of the push-button and flexibility in the direction of "push" is provided by the spring indicated.



Start-stop switches with metal box container partially dismantled to show the unit system assembly

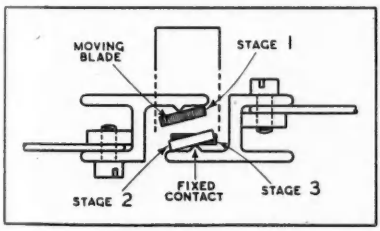


Fig. 1.—Operation of fixed and moving contacts

These switches can be used for making and breaking a circuit, as for start-stop, or for breaking one circuit and making another. When the button is pushed the moving blade is transferred from one set of contacts to the other against the pressure of a helical spring. Immediately the finger is removed, the spring reasserts itself and the moving blade is returned to its original position, Fig. 1 being intended to indicate the progress of the moving blade from one set of fixed contacts to the other. The second and third stages are important because a cleaning and rubbing action takes place as the moving contact straightens out from the tilted to the symmetrical position. Incidentally, the portion of the moving contact surface which is subjected to rubbing and cleaning is faced with silver.

The internal design of the housing is ingenious. Each half is recessed (Fig. 2) the unshaded portions accommodating the fixed contacts. When the top and bottom housings are placed together the shaded surfaces meet at the centre line of the box (before being attached to the bottom housing, the top housing is moved through 180 deg. relative to the bottom housing). Parts of the raised surfaces marked "X" and shown black engage with the surfaces marked "Y," thus securely registering the two halves while the screws which hold the two are introduced and tightened up. Mica windows are let in on each side of the assembly in order to enable

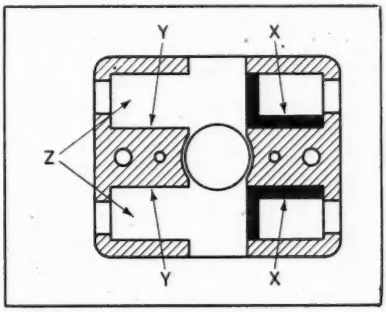
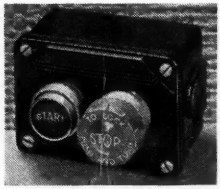


Fig. 2.—Internal view of contact housing

the action of the contacts to be watched. The mounting of the block type push-button switch can be done in a variety of ways. For instance a " start/stop " face-plate can carry two of these switches side by side at the back of the flush front plate; or they



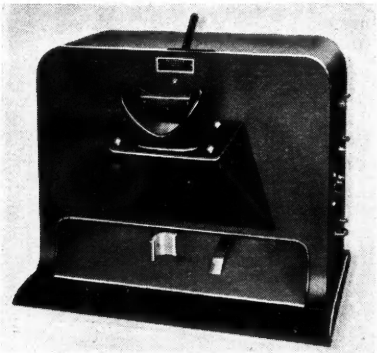
Switch incorporating locking device on the " stop " circuit

may be enclosed in a weather-proof metal box and the " stop " button fitted with a special screwed shroud or cap. When depressed and then rotated in a clock-wise direction, the " stop " button will be locked in place leaving the " stop " circuit open until reset by rotating the shroud in an anti-clockwise direction.

Crack Detection

AMONG the several methods of crack detection now being practised is that involving fluorescent indication for which simple equipment has been developed by Metropolitan-Vickers Electrical Co., Ltd.

The apparatus consists of the inspection cabinet, together with a tank unit approximately 2 ft. by 2 ft. 6 in. in plan, divided into three equal compartments for impregnating, cleaning and drying respectively. The impregnating tank contains a solution of fluorescent material with an additional constituent to enhance the penetrating quality of the solution. It is recommended that at least an hour should be allowed for soaking the components in this tank. They are then dipped in the cleaning tank to remove all the solution adhering to the surface, and finally covered with fine wood sawdust in the drying tank and left there for about 15 minutes to dry the surface thoroughly, leaving the fluorescent fluid in any cracks. After brushing off any clinging sawdust with a dry brush the samples are then ready for examination by insertion into the aperture in the inspection cabinet.



Inspection cabinet of the Metrolux fluorescent crack detection equipment

A mercury vapour discharge lamp housed inside the top of the cabinet floodlights the specimens collectively with ultra-violet light and in a few minutes any cracks in the surface are shown up vividly by fluorescence. If it is desired to devote particular attention to an individual case, the lever at the top is moved which causes a lens to swing into position beneath the discharge lamp and thus focus the rays on to the required point, resulting in increased fluorescence. Injurious short-wave radiation from the discharge lamp is removed by a black glass filter envelope round the lamp. Reflected ultra-violet rays also cause eyestrain and certain internal parts of the eye may themselves fluoresce, thus causing some fogging of the vision. For these reasons the eye-piece is provided with an ultra-violet filter which helps, incidentally, to accentuate the fluorescent markings.

The hooded " Metrolux " cabinet dispenses with the necessity for a dark room and the fluid baths are provided with lifting trays to facilitate handling the components. An electrical heater in the fluorescent solution tank maintains the solution at the most suitable temperature. It should be emphasised that the process cannot be hurried; the periods for soaking and drying specified above are the minima and if increased will often give still more satisfactory results.

Fluorescent crack detection is applicable only to cracks in the surface, but it will expose surface cracks, folds or porosity in metals, cracks in ceramics or plastics, non-adhesion of bearing linings and location of leaks in glass-metal seals of vacuum equipment.

Water-Power in Peru

PERU'S plans for developing an industrial economy based on abundant mineral resources are being carried out under difficulties of extreme shortage of machinery. Where possible, hand labour is being used to minimise the need for mechanised equipment. The development programme for the Chimboto Bay—Santa River region includes the erection of a 125,000-kW hydro-electric plant on the Santa River. Two of the projected five 25,000-kW units are expected to be installed by the end of this year at a total cost of about 23 million soles.

Plans for the northern region provide for a hydro-electric power installation on the Maranon River in the region of the Manseriche rapids. The proposed building of a monolithic dam in the Huacanqui Gorge would enable a power station to be erected with two 44,000-kW units. Later on further new power stations would be built. In addition to the electrification plans for Peru, the Chimbote Bay—Santa River programme provides for mineral development, steel plant construction and irrigation of thousands of acres of desert. It is planned to develop the anthracite reserves in the Santa River valley, estimated at 10 million tons. The irrigation programme aims at providing a supply of water to 250,000 semi-arid acres.—*Reuter's Trade Service.*

Argentine Overseas Trade

Imports and Exports in 1943

THE Argentine Government has made public full details of the foreign trade of the Republic for 1943. From this statement the figures in Table I have been extracted showing the imports, by the principal countries of origin, of electrical machinery and apparatus during that year, with a note of increase or decrease compared with 1942. All values are real values, not (as formerly Argentine practice) arbitrary values fixed by the Customs. As a whole this trade declined by more than a half during the year under review, the falling off being relatively more marked in the machinery and cable groups than in other apparatus. The only noteworthy increases were in vacuum cleaners, meters, and telephone and unspecified cables. A feature of the origin of electrical imports was the advance of Sweden, while Britain was able to maintain only a small share of the business. Further, Canada which in 1942 was fairly well represented among the countries supplying meters and telephone materials, did nothing worth recording in

TABLE I—IMPORTS

Class of Goods and Country of Origin	1943 Pesos (000)	Inc. or dec. on 1942
Fan motors—	8	− 188
„ United States	1	− 181
„ United Kingdom	3	+ 1
„ Switzerland	5	+ 5
Motors up to ¼ HP—	16	− 130
From United States	9	− 125
„ Sweden	6	
Motors and dynamos over ¼ HP—	2,568	− 1,570
From United States	325	− 1,289
„ United Kingdom	172	− 638
„ Sweden	1,721	+ 450
Other electric dynamos—	3	+ 2
Cable and wire up to 5 mm., covered with cotton, rubber, etc.	130	− 692
From United States	78	− 259
„ United Kingdom	4	− 265
Ditto, over 5 mm. (From United States)	2	− 63
Cable and wire up to 5 mm., lead-covered	159	− 147
From United States	59	+ 31
„ Sweden	100	− 57
Cable and wire, silk-covered (From United States)	2	− 86
Wire, electrical, enamelled	76	− 174
From United States	75	− 123
Electric cable, unspecified	494	+ 312
From Sweden	482	+ 363
„ United States	10	− 42
Telephone cables, iron or steel	245	+ 142
From United States	245	+ 161
Telephone cable, underground	133	− 390
From United States	36	+ 19
„ United Kingdom	47	− 399
„ Sweden	50	+ 12
Electrical flex—	158	− 187
From United States	13	− 285
„ United Kingdom	29	+ 3
„ Sweden	116	+ 97
Telephones without coils—	109	− 22
From Sweden	109	− 2
Telephones with coils—	606	− 118
From Sweden	487	− 56
„ United States	118	+ 118
Telephones, magneto—	167	− 5
From Sweden	163	+ 4
Telephone materials—	418	− 247
From United States	132	− 302
„ United Kingdom	126	− 38
„ Sweden	123	+ 66
„ Switzerland	32	+ 32
Telegraph material—	14	− 49
From United States	1	− 9
„ United Kingdom	13	− 16
Heaters, toasters, kettles, etc.—	2	− 27
Vacuum cleaners—	707	+ 355
From United States	2	− 11
„ Sweden	705	+ 408
Switches, circuit breakers, cutouts, fuses, etc.—	222	− 599
From United States	47	− 322
„ United Kingdom	53	− 114
„ Switzerland	66	+ 30
Change-over switches, including telephone stations—	1,825	− 1,842
From United States	288	− 188
„ United Kingdom	238	− 1,381
„ Sweden	1,280	+ 117
Electric incandescent lamps—	1,790	− 780
From United States	857	− 319
„ United Kingdom	233	− 541
„ Sweden	651	+ 66
Current meters—	3,727	− 344
From United States	12	− 122
„ United Kingdom	5	− 8
„ Sweden	574	+ 228
„ Switzerland	3,136	+ 1,325
Ammeters and voltmeters—	42	− 94
From Sweden	34	+ 33
Accumulator and battery parts—	516	− 1,145
From Canada	63	− 72
„ United States	224	− 836
„ United Kingdom	89	− 67
„ Spain	116	− 41
Batteries—	85	+ 54
From United States	26	+ 9
„ Sweden	58	+ 58
Cells for batteries and accumulators	*42	− 8
Glass bulbs for lamps and valve manufacture—	426	− 512
From United States	426	− 394
Electrical materials, unspecified—	2,043	− 2,247
From United States	1,075	− 1,681
„ United Kingdom	511	− 94
„ Switzerland	206	− 310
„ Sweden	183	− 75
„ Germany	28	− 216
Insulating tubes—	10	− 20
From United Kingdom	6	+ 1
„ United States	3	− 19
Radio-telephone apparatus—	99	− 218
From United States	85	− 224
Radio receiving sets—	367	− 427
From United States	309	− 465
„ United Kingdom	3	− 6
Radio amplifiers—	9	− 45
From United States	8	− 44
Loudspeakers—	27	− 407
From United States	26	− 350
Radio-telephone materials—	703	− 4,223
From United States	611	− 3,971
„ United Kingdom	47	− 270
„ Sweden	6	+ 6

* Mainly from U.S.A.

those lines in the year under review. (£1 equals about 17 pesos).

Table II gives the values of the exports of electrical manufactures. It will be noticed that neighbouring Latin American countries are Argentina's principal customers, the only exception worth mentioning in the electrical trade being South Africa, with a small quantity of unspecified material. There was a setback in radio exports although they remained the leading item. There are a dozen large factories making radio sets, the United States, Great Britain and Holland all being represented with branch works.

In addition there are about 3,000 smaller manufacturing or assembling concerns. For the most part, the raw materials used in radio manufacture have been imported, mainly from the United States. Before the war between 75 and 80 per cent. of the components were imported but this proportion has been dwindling as local manufacture has grown in scope. The U.S. Department of Commerce however reported a few months ago that high costs combined with lack of research were still handicaps on local production. The Argentine industry is well protected by a tariff on imports.

TABLE II—EXPORTS

Class of Goods and Destination	1943 Pesos (000)	Inc. or dec. on 1942
Electric generators—	76	+ 48
To Brazil	4	+ 4
,, Peru	67	+ 67
,, Paraguay	5	+ 5
Electric motors—	105	— 6
To Brazil	15	— 6
,, Chile	29	— 23
,, Peru	36	+ 22
Accumulators, batteries and parts—	605	+ 572
To Bolivia	53	+ 47
,, Colombia	260	+ 260
,, Chile	77	+ 70
,, Ecuador	44	+ 44
,, Venezuela	117	+ 117
Radio apparatus and parts—	1,059	— 2,356
To Bolivia	143	+ 63
,, Brazil	384	— 870
,, Chile	371	— 211
,, Paraguay	53	— 197
,, Peru	19	— 194
,, Uruguay	53	— 187
Telephone apparatus and parts—	169	— 96
To Bolivia	11	+ 10
,, Brazil	49	— 16
,, Chile	62	— 64
,, Paraguay	30	— 12
,, Uruguay	13	+ 5
Incandescent lamps—	53	— 353
To Bolivia	8	— 23
,, Ecuador	6	— 1
,, Paraguay	21	— 29
Other electrical materials—	1,520	+ 403
To Bolivia	198	+ 51
,, Brazil	30	— 38
,, Colombia	163	+ 140
,, Chile	291	— 20
,, Ecuador	113	+ 94
,, Paraguay	96	+ 56
,, Peru	257	— 49
,, South Africa	51	— 5
,, Uruguay	116	+ 58
,, Venezuela	84	+ 4

Forthcoming Events

Saturday, May 26th.—*Bristol.*—Victoria Rooms, 3 p.m. I.E.E. Bristol Students' Section. Annual general meeting and lecture illustrated by slides and films on "Some Hydro-Electric Possibilities and Achievements," by W. A. Hatch, M.B.E.

Birmingham.—12.30 for 1 p.m. Grand Hotel. Birmingham Electric Club. Luncheon.

Monday, May 28th.—*London.*—Institution of Electrical Engineers, 7 p.m. London Students' Section. Annual general meeting.

Tuesday, May 29th.—*London.*—Anatomy Theatre, University College (entrance from Gower Street), 1.15 p.m. Lecture (postponed from May 8th) on "The Future of Domestic Heating and Lighting," by Prof. R. O. Kapp. No fee or ticket is required.

London.—At Institution of Electrical Engineers, 6 p.m. Television Society. "The Human Eye and the Photo-cell," by Dr. W. Sommer.

Wednesday, May 30th.—*London.*—Institution of Electrical Engineers, 5.30 p.m. Transmission Section. "Localisation of Faults in Low-Voltage Cables, with special reference to Factory Technique," by J. H. Savage (postponed from May 9th).

London.—At Royal Institution, Albemarle Street, 3 p.m. Society of Chemical Industry, Plastics Group. First Baekeland Memorial Lecture, "Leo Hendrik Baekeland: The Story of his Life," by H. V. Potter.

Birmingham.—James Watt Institute, 7 p.m. I.E.E. South Midland Students' Section. Annual general meeting and paper on "Electrical Technique in Resistance Welding," by T. E. Calverley.

Manchester. — Engineers' Club, 5.30 p.m. I.E.E. North-Western Centre. Informal meeting in connection with the formation of a Measurements Group.

Thursday, May 31st.—*London.*—At Institution of Mechanical Engineers, 10.30 a.m. Institute of Fuel. Conference on "Industrial Insulation." Members of all other Institutions, Research and Trade Associations are invited to take part.

Friday, June 1st. — *Manchester.* — Reynolds' Hall, College of Technology, 6.30 p.m. Institution of Electronics (N.W. Branch) and Institute of Physics (Manchester and District Branch). Lecture on "Design of Electron Guns of Radial Symmetry," by Dr. H. Moss.

Monday, June 4th.—*London.*—At Royal Society of Arts, Adelphi, 5.30 p.m. Institution of Electronics. "Principles of Triode Design," by Dr. J. H. Fremlin.

Saturday, June 16th.—*Stratford-on-Avon.*—I.E.E. South Midland Students' Section. Summer outing to see "Twelfth Night."

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specifications (1*s. each*) *may be obtained from the Patent Office*, 25, *Southampton Buildings, London, W.C.*2.

HARON.—" Electrical heating and forging of billets." 18018. November 1st, 1943. (569120.)

W. Baumann.—" Connecting clamp for electric conductors." 1517/43. January 29th, 1942. (569104.)

Birmingham Electric Furnaces, Ltd., and P. F. Hancock.—" Process for the manufacture of iron powder." 5761. April 10th, 1943. (569011.)

British Thomson-Houston Co., Ltd.—" Dynamo-electric machines." 15095/42. October 30th, 1941. (569006.) " Diesel-electric and like power systems." 13401/42. September 25th, 1941. (569102.)

F. C. Draper and J. Shaw.—" Appliances for bending tubes, rods and the like." 14715. October 20th, 1942. (569130.)

Dubilier Condenser Co. (1925), Ltd., and K. A. Gough.—" Electrical condensers." 17488. October 23rd, 1943. (569060.)

Everett, Edgcumbe & Co., Ltd., and F. E. Ockenden.—" Instruments adapted for remote indication, control and such like by electrical means." 16976. October 15th, 1943. (569025.)

H. J. Houlgate, G. C. Wheeler and G. R. Fountain, Ltd.—" Electric amplifiers." 18826. November 12th, 1943. (569031.)

Igranic Electric Co., Ltd.—" Controllers for travelling bridges." 10684/43. July 16th, 1942. (569017.)

Landis & Gyr Soc. Anon.—" Multiple tariff counting mechanism for measuring instruments." 9317/43. July 7th, 1942. (569075.)

Marconi's Wireless Telegraph Co., Ltd.—" Control circuits, particularly for automatic frequency control and remote tuning." 6586/42. May 14th, 1941. (569044.) " Variable permeability inductance devices." 17955/43. October 31st, 1942. (569091.)

F. Newton.—" Automatic regulation of alternating current electric supply systems." 5419. April 5th, 1943. (569049.)

Plessey Co., Ltd. (P. R. Mallory & Co., Inc.).—" Rotary electric switch." 17600. October 26th, 1943. (569027.)

O. I. Price.—" Electromagnetic devices." 10191. June 24th, 1943. (569016.)

Standard Telephones & Cables, Ltd.—" Manufacture of spiral vacuum tube filaments." 3798/43. March 11th, 1942. (569048.)

Standard Telephones & Cables, Ltd., and T. W. Wingent.—" Methods of sealing metal to glass." 18108. November 2nd, 1943. (569150.)

Standard Telephones & Cables, Ltd., V. J. Terry and R. Kelly.—" Fault-indicating devices for electric supply systems." 17610. October 26th, 1943. (569028.)

A. Tustin and Metropolitan-Vickers Electrical Co., Ltd.—" Electric motor control systems." 6986. May 31st, 1941. (569004.)

Victor Products (Wallsend), Ltd., and R. W. Mann.—" Electric indicating devices applicable to gate end boxes and the like for use in mines." 12076. July 24th, 1943. (569021.)

Westinghouse Brake & Signal Co., Ltd.—" Railway traffic controlling apparatus." 4298/41. November 29th, 1940. (569095.)

Wright & Weaire, Ltd., and E. S. Buckley.—" Contacts of interrupters of vibrators for electrical circuits." 17354. October 21st, 1943. (569088.)

Registered Contractors

THERE was a net decrease of nine in the number of registered electrical contractors during 1944, the total at December 31st last being 1,332. The report for the year of the National Register of Electrical Installation Contractors, presented at the annual meeting yesterday (Thursday) shows that 32 applications were received of which 14 were accepted and four declined ; 14 remaining under consideration at the end of the year. Twenty-two contractors were removed from the Register, half of them for failing to renew registration (no reasons given), seven on account of death or the closing down of businesses and the rest for various other reasons.

During the year 125 visits of inspection were made. In 28 cases work was found satisfactory; in 78 faults for correction were disclosed; the other 19 were inspections of applicants' work. Funds have been allocated to a staff pension fund (£200).

Reference is made to meetings of the Registration Board with the National Committee on Statutory Wiring Regulations and Registration as a result of which Messrs. F. W. Purse and T. W. Heather were nominated to represent the Register on the National Committee.

The accounts show an income of £3,313 and a surplus for the year of £119. The chief items on the expenditure side were office salaries and national insurance £866; inspection salaries £807; inspection expenses £317; income tax £293; and rent, lighting and heating £249. The revenue was derived mainly from renewal fees and duplicate certificates (£2,947) and there was interest on investments amounting to £252. Investments at cost appear in the balance sheet at £7,577.

Patent Extension Application

Hoover, Ltd., has made application for the extension of its patent No. 258196 of 1943 (a regrant of a patent dated January 12th, 1926), for " Improvements in or relating to suction sweepers " for a period of one year and ten months " or such period as the Court shall think fit." The hearing will be on July 10th and any notice of opposition must be lodged at Room 239, Royal Courts of Justice, Strand, W.C.2, at least eleven days before that date, copies being sent to the Solicitor to the Board of Trade and to Bristows, Cook & Carpmael, solicitors, 1, Copthall Buildings, E.C.2.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Amble.—June 14th. Electricity Department. L.v. mains and distributors, feeder pillars and services. (May 18th.)

Australia. — PERTH. — June 21st. Government of Western Australia. Switchgear, motor-generator sets and batteries. (May 4th.)

Dunbar.—June 9th. Town Council. Supply and installation of street lighting equipment including poles, lanterns, wiring and control gear. Specs. from burgh surveyor.

Manchester.—June 5th. Electricity Committee. Low-pressure pipework, etc., at the Stuart Street generating station. 10,000-kVA transformer, Denton (West) substation. (May 18th.)

Salford.—May 26th. Electricity Department. Steel street lighting standards. (May 4th.)

Orders Placed

Cardiff.—Electricity Committee. Accepted. Two switch units (£1,276).—Allen West & Co. Switch to control busbar ring circuit (£2,200).—Metropolitan-Vickers.

London.— HAMMERSMITH. — Electricity Committee. Recommended. Twin-core non-bleeding type cable (extension of contract for twelve months).—Pirelli-General Cable Works.

Middlesbrough.—Town Council. Accepted. Electrical work in connection with the repair of war-damaged houses (£139).—Watson & Coates.

Stockton-on-Tees.—Town Council. Accepted. High-voltage switchgear—A. Reyrolle & Co., and low-voltage switchgear for new substations.—W. Lucy & Co.

Walsall.—Electricity Committee. Accepted. Two 500-kVA transformers (£476 each).—Brush Electrical Engineering Co.

Warrington. — Electricity Committee. Accepted. Transformers for twelve months.—Electric Construction Co.

West Hartlepool.—Corporation. Accepted. Six 500-kVA transformers.—Bonar, Long & Co.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Barnton (Northwich).—Hall, library, theatrical accommodation, etc. (£10,000), for Parish Council; Clerk to the Council, Barnton, Northwich, Cheshire.

Blackpool. — Houses (32), St. Walburgas estate; borough engineer.

Burton-on-Trent. — Houses (300), Waterside estate; borough engineer.

Cardiff.—Rebuilding premises after fire, Green Farm (£5,000); city engineer.

Carlisle.—Houses (241) for the City Council; city engineer, 18, Fisher Street, Carlisle.

Cheltenham. — Boiler house, Alpha House; Spirax Manufacturing Co.

Dearham (Cumberland).—Houses (40) for the North-Eastern Housing Association; P. L. Browne, Son and Harding, Pearl Buildings, Northumberland Street, Newcastle-on-Tyne.

Dumbarton.—Clinic, Hillfoot (£2,700) for County Council; county clerk.

Douglas (Isle of Man).—Houses (118), Spring Valley estate; borough engineer.

Durham.—Central kitchen at Wheatley Hill; county architect, 34, Old Elvet, Durham.

Essex.—Canteen, Garrison Hill school, Purfleet (£1,077); county architect.

Hebburn-on-Tyne.—Storage depot at the junction of Whinney Lane and Victoria Road West for the Ministry of Works.

Kent. — School improvements, Chatham (£13,000) and huts at technical schools, Bromley (£10,000); county architect, Maidstone.

Liverpool.—School canteen; Lloyd & Cross, Ltd., 68, Argyle Street, Birkenhead.

Macclesfield.—Two medical wards as extensions to general Infirmary (£10,000); J. F. Morton, secretary.

Morpeth.—Completion of 16 houses for the R.D.C.; surveyor, Council Offices, Dacre Street.

Newcastle-on-Tyne. — Additions to pathological laboratory at the Shotley Bridge Emergency Hospital for the City Council; city architect, 18, Cloth Market, Newcastle.

Fancy leather goods factory for E. Swann, Ltd., Northampton.

Newport (Isle of Wight).—Reconstruction, Westminster Bonemill, for S. Cooper & Sons; F. Chiverton, architect.

Rochdale.—Three schools at Kingsway, Kirk Holt and Spotland; S. H. Morgan, borough surveyor, Town Hall.

Stretford.—Rebuilding 23 houses, Dalton Avenue; J. Maunders & Sons, Ltd.

Sunderland.—Houses (800) on various sites; borough engineer.

Warwickshire. — Central kitchen, senior school, Stratford-on-Avon; county architect.

West Hartlepool.—Additions to factory and office, Murray Street for T. Relton & Son, Ltd.; R. Rowe, architect, 6, Scarborough Street, West Hartlepool.

Rebuilding five war-damaged houses, Rift House estate; borough engineer.

Whitley Bay.—Houses on 23 acres of land near the Foxhunter's Inn; U.D.C. surveyor.

Wolverhampton.—Extensions to nurses' home at Royal Hospital; superintendent.

Worcestershire.—School huts, Rubery; county architect.